THE

Practical Teacher

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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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Hygiene.

BY ALFRED CARPENTER, M.D., M.R.C.P. (LOND.).

HOW TO PREVENT DISEASE IN SCHOOL AND HOME (*continued.*)

Measles (*continued*).—Its contagiousness is fully developed at a very early stage. A child suffering from the disease may infect another before the nature of the malady is fully manifested. Here is the great difficulty in repressing the extension of the disease in thickly peopled neighbourhoods and especially in schools. It seems to be a disease peculiar to childhood, but the true reason for this is its virulent insidiousness; for very few children escape some time or other exposure to infection and in consequence they obtain the protection which this class of disease affords, viz.: an immunity from second attacks, although in regard to measles, the immunity is somewhat less decided than is the case with other zymotic diseases. Second and third attacks of the disease are not uncommon, though it may be that some of the reported cases are not truly recurrent attacks, but are thought to be so from incorrect diagnosis as to the nature of the preceding illness. The case may have been one mistaken for measles, for there are difficulties in the way of recognition. Slight attacks of other diseases having been ranked as measles by the ignorant practitioner of former times or by nurses and parents not having thought it necessary to obtain the services of a qualified medical man. It is necessary for the purposes of repression that an infectious disease should have early recognition, but the long stage of incubation, and the sudden development of infectiveness, prevent the establishment of hygienic measures, in the case of measles, before the mischief has spread sometimes to a large number of persons. The invasion of the disease is marked by the symptoms which ordinarily belong to 'a cold,' 'simple catarrh,' 'hay fever,' or other anomalous conditions, but not being generally preceded by the lassitude and debility which ushers in some others of the zymotic class. The victims apparently are often in rude health when the signs of the disease first manifest themselves by discharges from the eyes and nose, sneezing, sometimes nose bleeding, slight or more serious headache; the eyes become red, and there is a dislike to light; there is an irritating cough with tickling in the windpipe. If there are rigors or shivering, suspicion as to the possibility of infectious illness may be excited, but the disease is spread to those who are susceptible before the succeeding fever is really manifest, though the thermometer would have shown its existence, if it had been used. The eruption makes its appearance on the third day, sometimes a little later, occasionally the development of the eruption is the first sign which calls attention to the nature of the disease, but the mischief has been done, and quarantine is seldom then effectual in preventing the spread of the evil, if the patient has been mixing with others in the meantime. The eruption first shews itself in slightly elevated but minute pinkish dots in a somewhat cresentic form, on the forehead and temples, cheeks and neck; it gradually diffuses itself on the whole of the body, from the face downwards, showing itself most strongly on the back of the body; then lastly on the thighs and extremities; fading away on the face and neck as it becomes more developed on the arms and legs. It is most marked on the fifth or sixth day of the disease and declines as rapidly as it made its appearance. There is a scurfy state of skin when the rash has been very decided, and which has been mistaken by the uninitiated as a result of scarlatina or German measles.

The fever may be very high (104°, 105°); it subsides with the rash, and temperature reaches its normal limit (if there are no complications) on the seventh or eighth day of the disease, and the patient should be well on the ninth or tenth day. Sometimes the rash and fever are very slight, and the patient appears to be quite well on the fourth or fifth day. It is these slight cases which assist most to spread the disease, and make its repression an absolute impossibility, for in practice it is found to be quite impracticable to isolate children who have only a slight running from the nose, and it is spread abroad before its presence is suspected. There is, however, a great comfort from the fact that if the hygienic surroundings of a given house or district are satisfactory, measles, like other zymotic

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maladies, is trivial in its effects, and is not a fatal disease. It only becomes so when hygiene has been neglected, when sanitary defects exist, when decomposing animal excreta abound, and when ventilation is allowed to be defective, and uncleanliness submitted to. In such cases measles becomes a virulent disease, it is complicated with convulsions, laryngitis, bronchitis, typhoid pneumonia, diarrhœa, dysentery, gangrene, and other fatal states which show themselves by a large mortality among those affected. A comparatively trifling ailment then becomes a fatal epidemic. When there are many fatal cases in a given district, the hygienic arrangements of that district are certainly culpably defective, but if limited in its fatality to a given house, the fault may rest with the individual inhabitants of that house in permitting uncleanliness in their own households. In severe weather the influence of temperature tells upon the children of the poor, who may be at the same time feeling the effects of injudicious or defective feeding, as well as that of bad air. I have been particular in describing measles, because of the tendency among the parents of poor children to avoid the expense of medical attendance, and the fact of its not being usually included among the diseases for which notification is demanded by sanitary authorities. Its presence ought to be notified, though it is not capable of repression. It is an error not to include it in the list of diseases to be notified to the authority. Districts invaded by measles require especial attention for the reasons given above. A large mortality from the disease indicates a laxness of sanitary supervision and worse than thoughtlessness somewhere. It is usual in some places to shut up the elementary schools when measles are prevalent in a district. There is no use in this proceeding among crowded populations. The children of the poor cannot be isolated, and the infected cases mix with others and are often placed in worse conditions as to sanitary surroundings than is the case in the school houses. It is the duty of the managers to exclude children who are really affected, and by keeping those who are well, at work, the disease may be limited by the master sending home for treatment all those who show signs on the conjunctional mucus membranes, or by having the characteristic cough, that they are sickening with the disease. It may be wise to shut up an elementary school, in thinly peopled districts in the country, for a fortnight or three weeks, but it is utterly useless to do so in London and other closely populated centres; indeed, I hold to the contrary opinion, viz., that it is better for the children to be at school. It is useless for the purpose in view, viz., prevention.

The etiology of measles is doubtful. I believe it to be due to a micro-organism which has an alliance with decomposing vegetable rather than animal matter. It spreads very rapidly over country districts, coincidently with the spread of manure upon arable lands, or rather in sequence to such use, it often appears a short time after such distribution, and I am inclined to connect them as cause and effect, but the character of the organism is not at present recognised by the savants who are engaged in cultivating cacozymes. The forcing bed upon which the cause of the disease increases and multiplies is the mucus membrane of the throat and respiratory tract, especially that of the conjunctival and nasal surfaces. It becomes applied by atmospheric diffusion to those surfaces, and after a long incubation it sets up the feverish stage which ushers in the disease. I have known the disease extend from one village to another at a distance of a mile and a half as the crow flies, though no communication had apparently passed between the children of the two villages, which were separated by a valley and a stream. It appears to me that quarantine under those circumstances is all but useless, though it would not be right to allow of promiscuous intercourse between those who are ill and those not affected. The patient should be isolated as much as is convenient if it be an only case, but if the disease be epidemic in the district isolation is comparatively useless. The temperature of the room in which the patient is treated should not be allowed to fall below 55°, it should be as cool as may be in the summer, but carefully regulated in winter; at the same time it must not be allowed to get too warm, ventilation being properly attended to. The disease is, however, more prevalent in the spring and autumn than in either of the extremes. It is apt to leave mischief behind it in a strong tendency to secondary abscesses and eruptions upon the skin, which come out after recovery from the fever. These results are indicative of either one or two causes: there may be a constitutional tendency in the system to tubercular or other hereditary disease, such as syphilis, which the measles assist to bring to the surface, and leads to its expulsion from the body, in which case the disease has been of service by precipitating an attack which might have done more mischief if it had not been routed out and brought to the surface. The other cause for the secondary results is a residence in an insanitary atmosphere, which has led to impurity in the blood of the patient before the disease was taken. These causes may be coincident, in which case there will be much danger to the child's life. The impure material is highly inflammable, and leads to the production of complications such as have been before mentioned, and which also often bring undeserved obloquy upon vaccination, the state of the child's blood being referred to the vaccine used. Fresh air and plenty of it, mild diet, especially milk, barley water with vegetable acids in diet drinks, with gentle aperients will be the treatment required. The case does not often require medical aid. When the fever has subsided, and the skin is desquamating, warm baths judiciously used, the head being carefully shampooed, and the hair trimmed, will very soon remove all cause for after evil. The attention of the washerwoman to the clothes, and free ventilation of the apartment will be all the hygienic measures which are required to be taken for the removal of infection from the house. It is useless to distribute the various disinfectants which are sometimes used. The mischief is so pre-eminently aerial, and its vitality kept up by causes which cannot be removed, that it is not of any use to take the measures which are so strongly recommended against diphtheria, scarlatina and small pox.

Hooping Cough.—The cough which attends upon measles is very similar in its character to hooping cough. This malady is often the forerunner of an epidemic of measles; it often follows one, so that there appears to be an alliance between the two diseases, and as regards etiology and prevention the same conditions apply. The causation is aerial, and it spreads by atmospheric means. It is probably produced by a micro-organism, whose especial habitats are the ventricles and sinuses of the larynx, and especially

the culs-de-sacs, named the laryngeal pouches, and which are situated in the upper and anterior part of the laryngeal ventricle, extending, when inflated, to some distance above the level of the vocal chords. These pouches become distended with mucus before the spasmodic cough comes on, and it is probable that the micro-organism is the cause of the irritation by which the mucus is produced; the fit is then manifested, and the pouch emptied of its contents. The narrow orifice leading to the pouches and its confined area also prevents the application of germicides by which the disease might otherwise be rapidly cured. It is quite as general as measles, one attack confers almost, if not quite, a perfect protection against a second, though it is not uncommon amongst aged adults. In these cases it is quite possible that the parasite may not be the true cause of the hooping cough, but other sources of irritation in the same place will produce the characteristic cough. The effect of the micro-organism is not limited to the spaces between the vocal chords, the whole of the respiratory tract is more or less affected, and when the system of the patient has been exposed to injurious influences, the disease is liable to be attended by similar complications to those of measles. The spasmodic cough which is the pathogmonic sign of the disease may last from 8 to 10 weeks or longer. It is likely to be longer if the weather is inclement, shorter if it be mild. It is therefore more satisfactory to get the infection at the end of spring than in the middle of autumn or the beginning of winter.

As far as treatment is concerned there is no medicine which has a direct influence on the disease. Some physicians recommend ipecacuanha and other expectorants. This is seriously wrong treatment, the true point is to supply fresh air, sunlight, and use those agents which prevent the growth of fungi. An atmosphere of creasote or carbolic acid if combined with plenty of oxygen is the best atmosphere that can be provided. A few grains of Bromide of Potassium in compound infusion of Roses, two or three times a day, diminishes the nerve irritation which may, if unchecked, lead to convulsion. If these rules are followed, the child kept well covered with warm clothing so as not to be chilled, and if the air is dry so that it may be allowed to be out of doors as much as possible in spite of the cold (provided there is a good appetite and it seems well after the fit is over), the child will be piloted through the disease without any danger to the constitution.

(*To be continued.*)

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How to teach the Babies.

BY JAMES BAILEY.

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CHAPTER IV.

MANAGEMENT AND DISCIPLINE.

HAVING dealt somewhat in detail with the Children, the School, and the Teacher, we are now prepared to enter intelligently on the consideration of the work for which this provision is made. The children being delivered into the hands of the teacher, what has she to do with them? What is the end proposed? What are the means and processes by which it is to be aimed at? Her purpose is so to train the children as to secure the healthful development of all their faculties and powers of body and of mind, and to do this by keeping both in healthful activity, and without doing violence to the nature of the child. Her work is to train the 'whole child,' body, mind, and heart, its physical, intellectual, and moral nature. A great part of school work, doubtless, is that of instruction in the ordinary sense, the imparting of information, and the giving of that knowledge which comes under the designation of school teaching. But more than this, and more important than it, is the general training to good habits, and the bringing to bear upon the conduct and life of the children those influences which go to the formation of their character. This is a prime element of all school work: it is emphatically so of the school education of very young children. Educationally, then, the first effort must be that of putting the mind into the most favourable condition for subsequent school instruction, rather than that of imparting the instruction itself, though this latter purpose is to be by no means neglected.

It has been already shown that the exigencies of the social conditions of our modern life form the only justification for taking children from their homes, at the early age at which so many are sent to school. Thus the infant school sustains a close relation to the home on the one hand, and the ordinary school on the other, and its conditions and requirements necessarily conform to those of both. 'The first or infant period of training may thus fall into two parts; in the one the family is the only source of influence; in the other the child may be subjected also to the influence of the infant school.' 'The precise relation of the infant school to its precursor, the family school, on the one hand, and to the common school on the other, is a point of the utmost importance to be clearly apprehended. Did we view the infant school as only a branch of the common school, our whole notion of its training would be vitiated. In that case the same branches of instruction would have to be taught in it, the same development of the individual mind to be aimed at; and the great recommendation of the infant school would be the alacrity and closeness with which it could tread on the heels of the common school with its reading, its ciphering, its grammar, its geography, and the like. And, worse still, that radical error which has vitiated so many efforts in infant education, the confounding of education with a little intellectual instruction so called, an error which threatened to choke the whole system when it had barely seen the light, would be confirmed in us, to the utter perversion of our labour. We are to view the infant school rather as falling under the family school; its training so far from being a forestalling of the work of the common school, as bearing the image of the family training. Accordingly, we must look to the family circle for many of our principles, as well as for the spirit and temper of our procedure.' *

Now this points us to the direction in which we are to look for our methods of dealing with the school thus constituted. While these methods must conform to those which experience and observation have shown to be best adapted for securing the ends contemplated in ordinary school work, we must modify them by the modes of treatment by which nature herself directs the mother and the father in their treatment of these little ones in the life of the family.

* *Currie*, 'Early and Infant School Education.'

The first consideration affecting the actual work of a teacher is that which deals with the management and control of the children. Prior to the work of instruction is that of arranging the ways and means of occupying time, of what shall be taught, where and how the children shall be placed, how they shall be controlled and governed. That is to say, the knowledge and the application of the knowledge, of organization, and of discipline, should precede the application of the knowledge of method. This sometimes seems to be forgotten, as though it were supposed that the one thing needed is that of *teaching*, that if a teacher knows how and what to teach, all is therefore secured. This is an error. Obviously the first thing necessary is to bring the children under good government, to put them in the way of willing submission to the authority of the teacher. Till this is done little progress can be made in the way of instruction.

From what has been said as to the relation of the infant school to the family and to the ordinary school, we see that our modes of management and of discipline must be special. Wherein does the speciality lie? Largely in the *nature of the child*. Take, for instance, that prime law of child life—'the law of happiness.' While we keep ever steadily in view the requirements of school discipline, we must act towards this end in subordination to this essential condition of happiness. So with respect to the incessant *activity* characteristic of childhood. A young child has no power of self-control sufficient to enable it to repress its tendencies to restlessness. Yet these are but nature's way of asserting the inability of children to keep body or mind for more than a few minutes in one fixed direction. Further, the extreme susceptibility of little children to surrounding influences, to excitements to fear, curiosity, or emotion of other sort, joined to their trustfulness, and ready yielding to those about them, constitutes a further claim to our careful adaptation of modes of dealing with them.

The teacher's first object then must be to secure that mastery over the children which is necessary to their complete and willing *obedience*. There must further be that quiet arrangement and conduct which constitutes good *order*. Nothing can be effectively done in school till these are secured, whether it have reference to the carrying on the daily work itself, or to the due results of its processes. And they are not less necessary to the systematic Moral and Intellectual training which goes to the formation of character, and on which so much of the happiness and success of the future life of the child depend. Obedience and Order are results of the process known as School Discipline.

To provide for the requirements of child nature, and to produce the results thus indicated there is one essential condition. Each child must be dealt with as one of a mass, not as an isolated individual. 'The most obvious peculiarity of the Infant School is that the child is educated in it, not individually, but as the member of a numerous society.' (Currie.) For good or for evil, for mischief or for profit, the influence of the children upon each other is at least as great as that of the teacher herself. It was this principle, called by the expressive, if quaint, phrase—'the sympathy of numbers,' on which Stow laid such great stress as an instrument of child training.

In a chapter on 'The social character of the Infant School,' Currie puts this phase of our work with admirable force. He shows how a little child, taken for the first time from the smaller circle of home, and placed in the midst of the community forming the Infant School, regards his new surroundings with strangeness, suspicion, distrust, it may be even with fear. These feelings gradually give place to confidence and to joy, under the kindly influence of a judicious teacher; the natural and genial companionship of many like himself; and the simultaneous treatment, and impression, feeling and action, of the society of his fellows. Treated as one body, they respond to the same impulses, are thrilled with the same hopes, animated by the same motives. This can be done only by the teacher dealing with all as one, stimulating their minds into genial natural action, along the same lines, and on the same subjects; interesting them by the same suitable methods of address; engaging them in the same physical exercises; binding all to each other and to herself by mutual sympathy. If the teacher by tact and skilful management, daily and hourly repeated, go for a while in the current of the children's feelings, if, thus gaining their confidence, she guide and control them, bring her superior power of will and of influence to bear upon them, and turn the subtle and potent feeling produced by their mutual action and reaction into the current of her own will, an immense power is gained. But to gain this power, and to retain it habitually, the teacher must centre in herself the affections of the children; must gain their entire confidence, accustom them to act in concert, to learn in concert; unite in common acts of devotion. She must teach the same holy lessons, and weld all into oneness of heart and of action. This being the general principle, it will be seen that the simultaneousness of action of the Infant School is by no means a mere expedient for economizing time and teaching power. It does this, but, 'it rests on the higher ground of necessity. It is of the very essence of the Infant School system, springing immediately from the root of it, and embodying the first principle of its existence.' 'Such is the foundation of that simultaneous action, with which under the name of collective or gallery lessons we are so familiar in the Infant School.' 'Wherever the common nature and common intelligence of the children are to be brought into play, simultaneous action is the proper medium; exercises of attainment, on the other hand, in which the child is acquiring some instrumentary branch of knowledge, require sectional, and as much as possible, individual action. Such is the principle of distinction.' (Currie). And it will be seen that by far the larger proportion of the work proper to 'The Babies' Class' is of the former kind.

The first thing to be done in commencing the work of such a class as we are considering is to train its members to orderly sitting, marching, various movements and exercises, to a ready taking their places, and to general obedience to the teacher's directions. Now the first condition of doing anything well, or learning anything rightly, is that of Attention. The purpose of much of the ordinary work of a school is the development of the power and habit of attention. By attention is meant the concentration of *mind* in any given direction. This attention must be a *voluntary* act on the part of the child. But the child cannot be forced or cajoled into yielding it, if for no other reason at least for this, that it is not as yet at the command of the *will*. An appeal to a young child to give you his

attention is in vain. He knows not what, or where it is, nor how to give it, and the unwisely reiterated insisting that he shall give it, only bewilder and confuse it, making impossible for the time, what was already sufficiently difficult. If this be so, then, is the matter a hopeless one? Are there no means of access to this important faculty? If there be, where is the key by which we may unlock so great a treasure? The answers are to be found in the fact that the attention of children depends on *exciting their interest.* Though not at the command of their will it is ever at the command of their emotions. Whatever a child is interested in, to that he gives eager heed. Awaken curiosity, sympathy, emotion indeed of any sort, and you have the key to the situation. Here is the secret of the teacher's power over young children. Feeling is quickly aroused. Susceptibility to impression of any sort is so quick that the danger lies in the ease with which it may be awakened, and the extent to which it may be carried. A discreet teacher, who has won the love of her young charge, has them completely at her command, and under her control, and can turn their attention and effort in any direction she may desire.

The mechanical bodily movements, and the quiet orderly sitting during lessons, depend much on the process of 'drill,' a technical and rather harsh substitute for the easier phrase 'physical exercises.' These simple disciplinary processes must be accompanied by the cheerful example of the teacher, whose easy, earnest, pleasant participation in them will be followed by the willing co-operation of her class. It is greatly helped by singing. A few simple rhymes, set to easy, cheerful music, are among the first things to be taught to the children. Singing is a wonderful power in child training. On commencing the work of an infant school, and pre-eminently of a 'Babies' Class,' much of the time should be occupied in this preliminary work of physical exercises, singing, and the simple drill, by which the children may be trained to conditions favourable to class instruction, and to the establishment over them of that influence of the teacher on which her power so greatly depends.

(To be continued.)

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Easy Steps in Trigonometry.

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ANSWERS AND HINTS TO SOLUTIONS.

CHAPTER IX.

1. Apply to numerator and denominator of fraction Form. D and 9. Multiply up, and expand by Form. 14, &c.

2. Perform multiplication implied and apply Form. 12 & 11.

3. Take the cos $4x$ to the left hand member and sin $2x$ tan x to the right and apply Forms. H, B, 4.

4. Tan x + 2 sin ^2x cot $2x$ = sin $2x$

$$= \frac{\text{Sin } x}{\text{Cos } x} + \frac{2 \sin^2 x \cos 2x}{2 \sin x \cos x}$$

$$= \frac{\text{Sin } x\,(1 + \cos 2x)}{\text{Cos } x} \text{ &c.}$$

5. Reduce the L.H.M. to a single fraction, and apply Form. 14, 15. Multiply numerator and denominator of resulting fraction by $\frac{1}{\sqrt{2}}$ and reduce by Form. 12, remembering that $\sin 45^\circ = \cos 45^\circ = \frac{1}{\sqrt{2}}$.

6. Let $\frac{a}{\cos \alpha}$, $\frac{b}{\cos \beta}$, and $\frac{c}{\cos \gamma}$ all $= \lambda$.

$$a^2 = \lambda^2 \cos^2 \alpha, \quad b^2 = \lambda^2 \cos^2 \beta, \quad c^2 = \lambda^2 \cos^2 \gamma$$

$$\frac{a^2 + b^2 - c^2}{2\,ab} = \frac{\lambda^2 (\cos^2 \alpha + \cos^2 \beta - \cos^2 \gamma)}{2 \lambda^2 \cos \alpha \cos \beta}$$

$$= \frac{(\cos \alpha + \cos \gamma)(\cos \alpha - \cos \gamma) + \cos^2 \beta}{2 \cos \alpha \cos \beta}$$

$$= \frac{2 \cos \frac{\alpha + \gamma}{2} \cdot \cos \frac{\gamma - \alpha}{2} \cdot 2 \sin \frac{\alpha + \gamma}{2} \cdot \sin \frac{\gamma - \alpha}{2} + \cos^2 \beta}{2 \cos \alpha \cos \beta}$$

but $\beta = 90^\circ - (\alpha + \gamma)$ $\therefore \cos^2 \beta = \sin^2 (\alpha + \gamma)$

$$\therefore \frac{a^2 + b^2 - c^2}{2\,ab} = \frac{\sin (\alpha + \gamma) \cdot \sin (\gamma - \alpha) + \sin^2 (\alpha + \gamma)}{2 \cos \alpha \cdot \cos \beta}$$

$$= \frac{\sin (\alpha + \gamma)\,[\sin (\gamma - \alpha) + \sin (\gamma + \alpha)]}{2 \cos \alpha \cos \beta}$$

$$= \frac{2 \sin \gamma \cdot \cos \alpha}{2 \cos \alpha} = \sin \gamma.$$

7. If $2A + 2B + 2C = 180^\circ$, $A + B + C = 90^\circ$

$2C + A = 90^\circ - (B - C)$

$\therefore$ Sin $(2C + A)$ = cos $(B - C)$

similarly with the other expressions.

$$\text{Cos } (B - C) + \cos (C - A) = 2 \cos \frac{B - A}{2} \cos \frac{B - 2C + A}{2}$$

and cos $(A - B) + 1 = 2 \cos^2 \frac{A - B}{2}$ or $2 \cos^2 \frac{B - A}{2}$

$$\therefore \text{L.H.M.} = 2 \cos \frac{B - A}{2} \left(\cos \frac{B - 2C + A}{2} + \cos \frac{B - A}{2} \right)$$

after which apply Form. D, &c.

8. Resolve $\sin^2 A - \sin^2 C$ into factors and apply Forms. B and D. Reduce $\sin^2 B$ to $\sin^2 (A + C)$, &c., &c.

9. Apply Form. B or D to two of the terms in numerator and denominator, reduce the other to a ratio of the other two angles, &c.

10. L.H.M. $= \sin^2 \theta \sin 3\theta \sin \theta + \cos^2 \theta \cos 3\theta \cos \theta$. Reduce sin 3θ sin θ by Form. G, and cos 3θ cos θ by Form. E, the rest is easy.

11. Multiply i., ii., iii., by a, b, c, respectively, add the first two and subtract from their sum the third, &c.

12. Tan $(A + B + C)$ = tan $[(A + B) + C]$

$$= \frac{\tan (A + B) + \tan C}{1 - \tan (A + B) \cdot \tan C}$$

Expand tan $(A + B)$ in the above, &c.

13. If $A + B + C = 180$; tan $(A + B + C) = 0$

$\therefore$ the numerator in 12 = 0; hence the identity.

14. Resolve $1 - \cos 2A$ and $1 - \cos 2C$ by Form. 10; apply to the other terms Form. F; introduce the condition and the identity will be easily proved.

15. Equate each fraction to some symbol, x

$$a \cos B = \frac{\sin A \cdot \cos B}{x}, \text{ &c., &c.}$$

$$\text{and } c = \frac{\sin C}{x} = \frac{\sin (A + B)}{x}; \text{ hence the identity.}$$

16. Reduce to cosines. Clear of fractions, and apply Form. 9, when we get $\cos \theta + \cos 3\theta + 2 \cos 3\theta - 2 (1 + \cos 2\theta) \cos 3\theta = 0$

$$2 \cos 2\theta \cdot \cos \theta - 2 \cos 2\theta \cdot \cos 3\theta = 0$$

$$\cos 2\theta (\cos \theta - \cos 3\theta) = 0$$

$$\text{and } 2 \cos 2\theta \cdot \sin 2\theta \cdot \sin \theta = 0$$

$\therefore$ Cos $2\theta = 0$ $\therefore 2\theta = 90^\circ$ or 270° &c. or sin $2\theta = 0$

$\therefore 2\theta = 0^\circ$ or 180° &c., and sin $\theta = 0$ $\therefore \theta = 0^\circ$ or 180° &c.

17. Take the $2 \sin^2 x$ to the R.H.M., apply Form. B and 10.
Whence answer $\cos 2x = 0$ $2x = 90°, 270°$, &c.
$\text{Sin } 7x = \frac{1}{2}$ $7x = 30°, 150°$, &c.

18. Add and subtract $\sqrt{2}$ thus—

$$2\sqrt{2} - \sqrt{2}(1 - \cos 2x) + \sqrt{2}\cos x + 2\cos x - 1 = 0$$

$$\therefore 2\sqrt{2} - 2\sqrt{2}\sin^2 x + \sqrt{2}\cos x + 2\cos x - 1 = 0$$

$$2\sqrt{2}\cos^2 x + \sqrt{2}\cos x + 2\cos x - 1 = 0$$

$$(\sqrt{2}\cos x - 1)(2\cos x + 1) = 0$$

$\therefore \cos x = \frac{1}{\sqrt{2}}$ $x = 45°, 315°$, &c.

$\cos x = \frac{1}{2}$ $x = 60°, 300°$, &c.

19. Apply Form. C to $\sin \frac{x}{2} \cdot \cos \frac{3x}{2}$. Resolve into factors.

Ans. $\sin x = 1$ or $x = 90°$

$\cos x = \frac{1}{2}$ or $x = 60°$ or $300°$, &c.

20. Ans. $\tan x = 0$ $\therefore x = 0$ or $180°$, &c.
or, $\tan x = 1$ $\therefore x = 45°$ or $225°$, &c.

21. From i. $\cos\theta = \frac{\tan\phi}{\tan\alpha}$

Draw an angle θ. let base $= \tan\phi$; hyp. $= \tan\alpha$;

$\therefore$ perpendicular $= \sqrt{\tan^2\alpha - \tan^2\phi}$.

and $\tan^2\theta = \frac{\tan^2\alpha - \tan^2\phi}{\tan^2\phi}$

Substitute this in ii. and reduce by Forms. 1, 2, 4.

22. From ii. $\left(\frac{x}{a\sin^2\theta}\right)^{\frac{1}{3}} = -\left(\frac{y}{b\cos^2\theta}\right)^{\frac{1}{3}}$

$$\therefore \frac{x^{\frac{1}{3}}}{a^{\frac{1}{3}}(1 - \cos^2\theta)} = \frac{y^{\frac{1}{3}}}{b^{\frac{1}{3}}\cos^2\theta}$$

$$\therefore \text{Cos}^2\theta = \frac{a^{\frac{1}{3}}y^{\frac{1}{3}}}{a^{\frac{1}{3}}y^{\frac{1}{3}} + b^{\frac{1}{3}}x^{\frac{1}{3}}}$$

Similarly $\sin^2\theta = \frac{b^{\frac{1}{3}}x^{\frac{1}{3}}}{a^{\frac{1}{3}}y^{\frac{1}{3}} + b^{\frac{1}{3}}x^{\frac{1}{3}}}$

Substituting in i. we get

$$\frac{x\sqrt{(ay)^{\frac{1}{3}} + (bx)^{\frac{1}{3}}}}{a(bx)^{\frac{1}{3}}} + \frac{y\sqrt{(ay)^{\frac{1}{3}} + (bx)^{\frac{1}{3}}}}{b(ay)^{\frac{1}{3}}} = 1$$

Multiplying by $\frac{(ab)^{\frac{1}{3}}}{\sqrt{(ay)^{\frac{1}{3}} + (bx)^{\frac{1}{3}}}}$ we get the expression asked for.

23. Square both equations, and subtract ii. from i.
$a^2 - b^2 = 0$. Ans.

24. Write $\cos 2\theta$ as $\frac{\cos 2\theta}{1}$

Subtract the numerator from the denominator for a new numerator and add them for a new denominator and apply Forms. 9, 10, 4.

25. From iii. express tan a in terms of tan β, get 2 expressions for tan 2 a and equate.
$m(n^2 - c^2) = nc(1 - m^2)$ Ans.

CHAPTER X.

GENERAL EXPRESSIONS FOR ALL ANGLES HAVING THE SAME SINES OR COSINES OR TANGENTS, &c.

147. Though a simple equation can only have one root, and a quadratic equation two and so on, yet there are innumerable angles which will satisfy the condition of an equation in one of its goniometrical ratios.

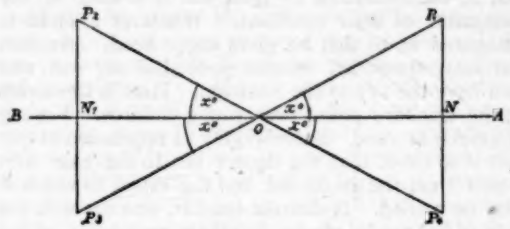
148. These different angles are not roots of the equation itself but correspond to the ratio or ratios which are the real roots of the equation.

e.g. $2\sin x = 1$

$\therefore \sin x = \frac{1}{2}$

and $x = 30°$, or $150°$, or $390°$, &c., &c.

The equation is not an equation in $x°$ but in the ratio $\sin x$, and of such there is only one root, viz. $\frac{1}{2}$.



149. Let P_1OA, and P_2OB, contain $x°$. Produce P_1O and P_2O; from P_1 and P_2 draw P_1N, P_2N_1 perpendicular to AB. Produce P_1N to meet P_2O in P_4 and produce P_2N_1 to meet P_1O in P_3. Then BOP_3 and AOP_4 both contain $x°$.

150. Let P_1OA or $x°$ be the least angle whose sine and cosecant are some known quantities a and $\frac{1}{a}$ respectively.

Then $\sin P_2OA$ *i.e.* $\sin(180 - x) = a$.

But if OP_1 has revolved round the circle, and come back to OP_1 *i.e.* generated an angle of $360° + x°$, the sine will be the same again.

Again if it revolve still further into the position of OP_2 and thus have generated an angle of $540° - x°$ the sine again will be the same.

Hence we have the same sine for these angles,
x, $180° - x$, $360° + x$, $540° - x$, ... $2n\,180° + x$,
$(2n + 1)\,180° - x$.
n being any integer.

151. If we suppose the angle generated by the line revolving clockwise, then the following negative angles will have the same sine as x, viz.
$-(180 + x)$, $-(360 - x)$, $-(540 + x)$, ...
$-(2n\,180 - x)$, $-[(2n + 1)\,100 + x]$
n being any integer.

152. We have to find an expression which will include all the angles mentioned in 150 and 151.

It will be noticed that in the positive angles when the multiple of $180°$ is an odd number, the sign of x is minus, and when it is an even number, the sign of x is positive.

Since $(-1)^n$ is positive or negative, according as n is even or odd, the positive angles will be expressed by $n.180° + (-1)^n x$.

Let us see whether this will also express the negative angles.

Let $n = -3$. In this case $n.180° + (-1)^n x = -3 \times 180° - x$ or $-(3 \times 180° + x)$ which we see is one of the negative angles whose sine is the same as the sine of x.

Hence if $\sin x = a$, or $\operatorname{cosec} x = \frac{1}{a}$ or $\operatorname{covers} x = 1 - a$, all angles which are included in the formula $n.180^\circ + (-1)^n x$, n being either 0 or any integer, positive or negative will have the same sine, cosecant and coversine.

153. Let $\cos P_1OA$ or $\cos x = b$. $\therefore \sec x = \frac{1}{b}$, and $\operatorname{vers} x = 1 - b$, $\cos P_4OA$ or $\cos(360^\circ - x) = b$, and all angles formed by adding any multiple of 2.180° to these two angles. $\therefore$ the following angles will have the same cosine, secant and versine, viz.

x, $2 \times 180^\circ + x$, $4 \times 180^\circ - x$, $4 \times 180^\circ + x$, &c.

And of negative angles with the same cosine, secant, and versine, we have

$-(2 \times 180^\circ - x)$, $-(2 \times 180^\circ + x)$, $-(4 \times 180^\circ - x)$, $-(4 \times 180^\circ + x)$, &c.

And these will be all included in the formula $2\,n\,180^\circ \pm x$, n being either 0 or any integer positive or negative.

154. Let $\tan P_1OA$ or $\tan x = c$ and $\cot x = \frac{1}{c}$, then $\tan P_3OA$ or $\tan(180^\circ + x) = c$, and all angles formed by adding any multiple of $2 \times 180^\circ$ to these two angles.

$\therefore$ the following angles will have the same tangent and cotangent, viz.

x, $180^\circ + x$, $2 \times 180^\circ + x$, $3 \times 180^\circ + x$, &c.

And of negative angles with the same tangent and cotangent we have

$-(180^\circ - x)$, $-(2.180^\circ - x)$, $-(3.180^\circ - x)$, &c.

And these will all be included in the formula, $n.180^\circ + x$, n being either 0 or any integer positive or negative.

155. For 180° let us write π (an abstract number between 3 and 4, which is an approximation, as near as we please, to the ratio of the circumference of a circle to its diameter); our unit of angular measure containing 59° and a fraction.

Hence $\sin(\sin^{-1} a) = \sin[n\pi + (-1)^n \sin^{-1} a]$ Form. 26.

and $\cos(\cos^{-1} b) = \cos(2n\pi \pm \cos^{-1} b)$ „ 27.

and $\tan(\tan^{-1} c) = \tan(n\pi + \tan^{-1} c)$ „ 28.

Form. 26 applying equally to cosecant and covers. Form. 27 applying equally to sec and vers. Form. 28 applying to cot.

Note.—When we come to treat of circular measure, the reason for denoting 180° by the symbol π will be thoroughly explained; at present it is only used for the sake of brevity.

156. Examination and Examples, X.

Write down the general expression for the angles which have the same

1. Sine as 570°.
2. Cosine as 1035^g.
3. Tangent as 25°.
4. Cosecant as -27^g.
5. Cotangent as -350°.
6. Secant as -1040^g.
7. If $\sin x^\circ$ and $\sin y^\circ = a$, and $\tan x^\circ$ and $\tan y^\circ = b$, what may we argue with regard to the angles x° and y°?
8. If $\operatorname{cosec} x^\circ = a = \operatorname{cosec} y^\circ$, and $\cot x^\circ = b = \cot y^\circ$; what may we argue with regard to the angles x° and y°.

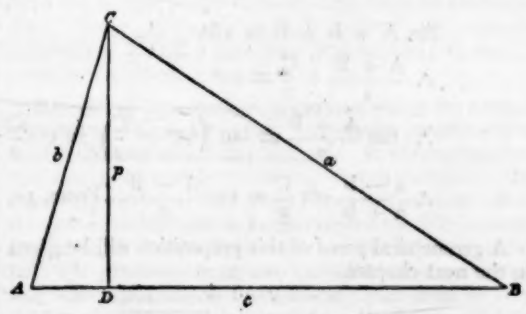
Solve the following equations giving the general answers, using inverse notation (if necessary).

9. $7\sin^2 x - 5\sin x + \cos^2 x = 0$.
10. $8\operatorname{cosec}^2 x - 7\operatorname{cosec} x - 6\cot^2 x = 0$.
11. $2\sin^3 x - \sin^2 x + 2\sin x\cos^2 x - \cos^2 x = 0$.
12. $\sin x \cos x = \frac{1}{2}$.
13. $\sin x \cos x - \frac{\cos x}{\sqrt{2}} + \frac{\sin x}{2} = \frac{1}{2\sqrt{2}}$
14. $\cos 4x + \cos 2x + \cos x = 0$.
15. $1 + \sin^2\theta = 3\sin\theta\cos\theta$.
16. $\sin 5\theta . \cos 3\theta = \sin 9\theta \cos 7\theta$.
17. $\tan(a + x)\tan(a - x) = \frac{1 - \cos 2a}{1 + \cos 2a}$.
18. If $\sin A + \sin B = \frac{1}{2}$,
$\cos A + \cos B = \frac{1}{3}$.
Find $\sec(A - B)$.
19. With the same data as in 18. Find $\cot(A - B)$.
Solve the following equations in x.
20. $\tan^{-1}\frac{1}{2} + \tan^{-1}\frac{1}{4} + \tan^{-1}\frac{1}{5} + \tan^{-1} x = 45^\circ$.
21. $\sin^{-1} 2x + \sin^{-1} 3x = \frac{\pi}{4}$ or 45°.
22. $\tan^{-1}\frac{1}{x-1} - \tan^{-1}\frac{1}{x+1} = 30^\circ$.
23. $\sin^{-1}\frac{1}{\sqrt{x}} + \sin^{-1}\frac{1}{\sqrt{2x}} = \frac{\pi}{4}$.
24. Write down the general expression for $\sin^{-1}(a + b)$.
25. Find x and y
if $\sin x + \sin y = \sqrt{3}$
$\cos x + \cos y = 1$.

CHAPTER XI.

THE RELATION BETWEEN THE SIDES OF A TRIANGLE AND THE GONIOMETRICAL RATIOS OF ITS ANGLES AND AREAS.

157. Many of the following easy propositions have already been solved as exercises to former chapters.



158. Let CAB be any triangle, and let the angles contain C, A, B, angular units respectively, and let the opposite sides contain c, a, b, linear units. And let CD (perpendicular on AB) contain p similar linear units.

159. To prove $c = b \cos A + a \cos B$.

$$c = AD + DB$$
$$= \frac{AD}{b} \cdot b + \frac{DB}{a} \cdot a$$
$$= b \cos A + a \cos B \text{.....Form. 29.}$$

160. From formula in 159 prove

$$\text{Cos } A = \frac{b^2 + c^2 - a^2}{2bc.}$$

since $c = b \cos A + a \cos B$..... i.

i. $\times$ c, $c^2 = bc \cos A + ac \cos B$..... i.

similarly $a^2 = ab \cos C + ac \cos B$..... ii.

and $b^2 = b c \cos A + b a \cos C$ ...iii.

i. + iii. — ii. $b^2 + c^2 - a^2 = 2 bc \cos A$

$$\therefore \text{ Cos } A = \frac{b^2 + c^2 - a^2}{2bc.} \text{ .....Form. 30.}$$

161. To prove $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

$$\frac{CD}{b} b = \frac{CD}{a} a$$
$$\therefore b \sin A = a \sin B$$
$$\therefore \frac{\text{Sin } A}{a} = \frac{\sin B}{b} = \text{(by symmetry)} \frac{\sin C}{c}$$
.....Form. 31.

To prove $\tan \frac{A - B}{2} = \frac{a - b}{a + b} \cot \frac{c}{2}$

162. From 161.

$$\frac{a}{b} = \frac{\sin A}{\sin B}$$
$$\therefore \frac{a - b}{a + b} = \frac{\sin A - \sin B}{\sin A + \sin B}$$
$$= \frac{2 \sin \frac{A - B}{2} \cdot \cos \frac{A + B}{2}}{2 \sin \frac{A + B}{2} \cdot \cos \frac{A + B}{2}}$$
$$= \frac{\tan \frac{A - B}{2}}{\tan \frac{A + B}{2}}$$

Sin A + B + C = 180°

$$\therefore \frac{A + B}{2} + \frac{C}{2} = 90°$$
$$\therefore \tan \frac{A + B}{2} = \tan \left(90° - \frac{C}{2}\right) = \cot \frac{C}{2}$$
$$\therefore \frac{a - b}{a + b} \cdot \cot \frac{C}{2} = \tan \frac{A - B}{2} \text{ ...Form. 32.}$$

A geometrical proof of this proposition will be given in the next chapter.

163. To prove $\cos \frac{A}{2} = \pm \sqrt{\frac{s(s - a)}{bc}}$ when 2s $= a + b + c$.

From 160. $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

$$\therefore 1 + \cos A = \frac{2bc + b^2 + c^2 - a^2}{2bc}$$
$$\therefore 2 \cos^2 \frac{A}{2} = \frac{2bc + b^2 + c^2 - a^2}{2bc}$$
$$\therefore \cos \frac{A}{2} = \pm \sqrt{\frac{2bc + b^2 + c^2 - a^2}{2 \times 2bc}}$$
$$= \pm \sqrt{\frac{(b + c + a)(b + c - a)}{2 \times 2bc}}$$
$$= \pm \sqrt{\frac{2s \cdot 2(s - a)}{2 \times 2bc}}$$
$$= \pm \sqrt{\frac{s(s - a)}{bc}} \text{ .....Form. 33.}$$

164. To prove $\sin \frac{A}{2} = \pm \sqrt{\frac{(s - b)(s - c)}{bc}}$

From 2nd line of above.

$$1 - \cos A = \frac{2bc - b^2 - c^2 + a^2}{2bc.}$$
$$2 \sin^2 \frac{A}{2} = \frac{a^2 - (b^2 - 2bc - c^2)}{2bc}$$
$$\text{Sin } \frac{A}{2} = \sqrt{\frac{(a - b + c)(a + b - c)}{4bc}}$$
$$= \pm \sqrt{\frac{(s - b)(s - c)}{bc}} \text{Form. 34.}$$

165. To prove $\sin A = \frac{2}{bc} \sqrt{s(s-a)(s-b)(s-c)}$

$$= \frac{2}{bc} S.$$
$$\text{Sin } A = 2 \sin \frac{A}{2} \cdot \cos \frac{A}{2}.$$

$\therefore$ from 163 and 164.

$$\text{Sin } A = 2 \sqrt{\frac{s(s-a)(s-b)(s-c)}{b^2 c^2}}$$
$$= \frac{2}{bc} \sqrt{s(s-a)(s-b)(s-c)}$$

If for $\sqrt{s(s-a)(s-b)(s-c)}$ we write S.

we get $\sin A = \frac{2}{bc} S$.....Form. 35.

166. To show that the area of a triangle $= \frac{1}{2} bc \sin A$.

Area $= \frac{1}{2} p c$

but $p = \frac{p}{b} b = b \sin A$.

$\therefore$ Area $= \frac{1}{2} bc \sin A$.....Form. 36.

167. To show that the area = S.

From 166 area $= \frac{1}{2} bc \sin A$

$$= \frac{1}{2} bc \cdot \frac{2}{bc} \cdot S$$
$$= S. \qquad \text{Form. 37.}$$

168. Other expressions for the area of a triangle will be given as exercises.

169. EXAMINATION AND EXAMPLES, XI.

1. From the formula proved in 165 prove the one in 161.

2. Find the area of an equilateral triangle whose sides are 4 feet.

3. Express tan $\frac{A}{2}$ in terms of s and the sides of the triangle.

4. Express covers $\frac{B}{2}$ in terms of s and the sides of the triangle.

5. Find cos A, if the sides a, b, c, be 20, 21, 29, respectively.

6. Find sin A with the data of 5.

Prove in any triangle the following relations—

7. $$\frac{a - b + c}{a + b + c} = \frac{\sin A - \sin B + \sin C}{\sin A + \sin B + \sin C}$$

8. $a + b + c = (a + b)\cos C + (b + c)\cos A + (c + a)\cos B$.

9. The angle between the two sides of a triangle whose lengths are 30 and 35, is 30°, find its area.

10. If a, b, c = 409, 169, 510, linear units respectively; find the area of the triangle in corresponding square units.

11. Prove that the area of a triangle $= \frac{1}{2} b^2 \sin^2 A (\cot A + \cot B)$.

12. Let P be any point within the triangle, and let α, β, γ, be the number of linear units in the perpendiculars from P on a, b, c, respectively; prove $\alpha a + \beta b + \gamma c$ = twice area of triangle.

13. In any triangle show that its area

$$= \tfrac{1}{2}(b^2 + c^2)\,\frac{a \sin B \sin C}{b \sin B + c \sin C}.$$

14. Divide the angle A into two parts that the sine of one part : sine of the other part as 2 : 3.

15. Divide the angle A into two parts that the cosine of one part : cosine of the other part as 3 : 4.

16. Show in Fig. in 158 that CD divides the angle C into two parts so that the tan of one part : tan of other part as AD : DB.

17. In every triangle prove $(a + c)\sin\frac{B}{2} = b\cos\frac{A - C}{2}$.

18. Prove that the area of the triangle whose sides are $\sqrt{29}$, $\sqrt{73}$, and $\sqrt{194}$ is $\frac{1}{2}$.

19. Prove in any triangle $a \sin (B - C) + b \sin (C - A) + c \sin (A - B) = 0$.

20. In a triangle, if C = 60°; a = 13; b = 7, find $\tan\frac{A - B}{2}$.

21. Draw the triangle whose side C is 4 in. and whose angles A and B are $\sin^{-1}\frac{3}{5}$ and $\sin^{-1}\frac{8}{17}$.

22. Find the side a of triangle in 21.

23. Find the area of triangle in 21.

24. Prove that the area of any triangle is $\frac{a^2 \cdot \sin B, \sin C}{2 \cdot \sin (B + C)}$.

25. Two lines of straight railway ABC and DEC meet at C, telegraph posts being situated at A, B, D, E. The angles DAE, DBE, are each equal to α and the angles EAB, EBC, are β, γ respectively. Show that

$$BC = AB\,\frac{\sin\beta \sin(\alpha + \beta)}{\sin(\gamma - \beta)\sin(\alpha + \beta + \gamma)}$$

(To be continued.)

—o—

The Elements of Mental and Moral Science as applied to Teaching.

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[These articles are specially written to meet the requirements of candidates who are reading for the certificate examination.]

JUDGMENT AND REASON.

JUDGMENT is a mental process by which, after a comparison of two terms, we assert that the one is or is not included in the other. As a concept is expressed by a term, so is a judgment by a proposition. Comparing the two terms 'lying' and 'base,' we find that all lying is included in the class of things which are base, and this we express in the proposition 'Lying is base.' In judgment terms are considered mainly as to their extension, but we have already seen that we can only understand extension by means of intension. We cannot say that lying is base, unless we know all the qualities connoted by these two terms

Propositions are divided into two classes according to their quality, that is, according as they are affirmative or negative. They may be also classified according to their quantity, that is, according as the whole of the subject or only a part of it is included under the predicate. There are thus four different classes of propositions usually indicated by letters for brevity:—

A—Universal Affirmative: All men are sinners.

E—Universal Negative: No liar is an honourable man.

I—Particular Affirmative: Some men are fools.

O—Particular Negative: Some men are not fools.

The converse of a proposition is that proposition with its subject and predicate transposed. 'No liar is an honourable man' may be converted into 'No honourable man is a liar.' But the simple converse of a proposition is not always true. It does not follow that because 'All schoolmasters are men,' 'All men are schoolmasters.' If we wish to draw a true conclusion from the former proposition we must limit its converse into 'Some men are schoolmasters.' By simple conversion E and I give true propositions; A and O must be modified.

Reasoning is a mental process in which by means of a series of interdependent judgments we arrive at a final judgment about any subject. It corresponds to the common phrase 'thinking out a subject.' In reasoning the mind may adopt either of two methods—inductive and deductive. Induction is a mode of reasoning in which from a few known facts we infer a general law. It proceeds from the known to the unknown, from the particular to the general; and from its very nature can never reach certainty. We know that no cat, dog, elephant, giraffe, pig, or squirrel, ever lays eggs. This suggests a general law, and after we have found hundreds of fourfooted animals that do not lay eggs we are led by induction to the statement 'No fourfooted animal lays eggs,' which is manifestly untrue since the

crocodile and the platypus are oviparous. The greater the number of cases observed, the more confidence we have in our inductions. We feel almost absolutely certain that the sun will rise to-morrow. Yet all we really know is that it has never in the experience of men failed to rise. Our belief that it will rise to-morrow is based upon the assumption which underlies all induction—the uniformity of nature. In the past all the forces of nature have obeyed fixed laws. Sometimes they have seemed to act erratically, but investigation has invariably proved that such aberrations only occur through the influence of some hitherto unknown law, and we take it for granted that: 'The thing which hath been, it is that which shall be.'

Induction is the mode in which reason acts when seeking to make discoveries. After a certain number of facts have been observed, the investigator makes a provisional theory or 'hypothesis' and afterwards tests to see whether this theory is in conformity with all available facts. In deduction 'hypothesis' is generally used in much the same sense, but it sometimes means merely the conditions under which a demonstration is to be made. For example in physical science in order to explain many ascertained facts scientific men have formed the hypothesis of the existence of an electric *fluid*. Subsequent investigation may raise this hypothesis into an established fact, or may prove the non-existence of such a fluid. In deductive logic on the other hand—as in Euclid—the hypothesis may amount to no more than such a definite statement as 'Let A B C be the given triangle.'

Analogy is the resemblance of ratios. Thus when we talk of the 'bed' of a river we do not mean that a river bed resembles an ordinary bed, but that it has the same relation to the river as our bed has to us. It is that which contains the river as our bed contains us. In this case the analogy only extends to one quality, we can make no inference from it. Such cases are mere metaphors. But sometimes analogy is a mode of inference. 'If after much observation of B we find that it agrees with A in nine out of ten of its known properties, we may conclude with a probability of nine to one that it will possess any given derivative property of A.' Thus the planet Mars agrees with the earth in being round, in revolving round the sun, in possessing air, moisture, mountains, variable climate and other qualities. Hence analogy infers that it resembles the earth also in being inhabited and that with the more certainty the greater the number of points in which the two planets agree. Analogy is thus seen to be a special kind of induction, and is based upon the same fundamental law of the uniformity of nature. In induction we examine a large number of objects and make a general law regarding them, in analogy we compare only two objects and infer their resemblance in some unknown quality from their agreement in more or fewer known qualities. If a sailor landing upon an unknown shore observes a hundred black men and no white, yellow, or brown men he concludes by induction that the country is inhabited by black men. If now he finds that these men have all broad lips, flat noses, woolly hair and small eyes he infers by analogy that they resemble African negroes in other respects as well.

Analogy is not such a reliable form of reasoning as induction, for it is very common in nature to find two objects accurately resembling each other in all points but one, and that one the most important of all. Thus skilful imitations of precious stones would by analogy certainly be regarded as genuine. The main cause of error in analogy is the practice of seizing upon striking though unimportant points of resemblance. A boy who sees a huntsman at once sets him down as a soldier. This kind of error is very common in school. Fanciful resemblances are often misleading. This kind of metaphorical reasoning is very dangerous. The whole of the confusion of Locke's philosophy originates in his too literal interpretation of the metaphor of the blank sheet of note paper. Speaking generally the cause of error in analogical reasoning lies in comparing the two cases in too few points.

Deduction is a mode of reasoning in which we pass from general laws to particular cases. It is the exact converse of induction, and is always absolutely certain of its results. Like induction it is based upon one general principle, but the deductive principle is not an assumption, but a self evident truth. 'What is true of a class is true of everything contained in that class.' The comparison of the wider and narrower terms is made by means of a syllogism. A syllogism is a form of reasoning in which, by means of two subordinate propositions, we reach a third proposition or conclusion.

All insects are six-legged animals;
A bee is an insect;
Therefore a bee is a six-legged animal.

In all syllogisms there must be just three terms—in this case insect, six-legged animal, bee. Of these the subject of the conclusion is the minor term (bee); the predicate of the conclusion the major (six-legged animal), and the term with which the other two are compared (insect) the middle term. The proposition containing the major term is called the major premiss, that containing the minor term the minor premiss.

A little thought will show that the conclusion really tells us nothing new. In order to know that a bee is an insect, we must know that it has six legs. In fact deductive logic denies all knowledge of the subjects with which it deals, and only asserts that 'if the premises be true, the conclusion must be true.' It is therefore utterly useless for discovery, and is of value only as a means of methodically arranging our knowledge. It follows induction as a mental process, and is the science of verification. Euclid's method is deductive throughout, and it may seem absurd to say that the boy who begins the study of geometry already knows all that he is about to learn. Yet, with the exception of the technical terms, the paradox is true. All Euclid is built upon the axioms, which may be defined as propositions expressing self-evident truths. Theoretical geometry is, in short, common sense applied to space-relations. This is seen in the well known story of Socrates making an ignorant boy demonstrate a geometrical theorem, by common sense answers to skilful questions. The Socratic method may be described as the arrangement of our ideas, by means of suitable questions, in such a way that we perceive all that underlies them. It cannot inform, it can only draw out.

A child must be *told* that Magna Charta was signed in 1215. Such facts are described as *a posteriori*, that is, facts which we can only learn from external sources. *A priori* is the opposite of *a posteriori*, and refers to knowledge not gained from experience. The Socratic

method, strictly understood, is applicable only to *a priori* knowledge, or as it is sometimes expressed, knowledge based upon first principles. A child who has never seen a salmon, and who has no notion how heavy a pound is, can be led by judicious questions to solve the problem 'What is the weight of a salmon, which weighs 7lbs. and half its weight?' But no amount of skilful questioning can lead the pupil to discover the position of a town he knows nothing about. Between these extremes are many problems which are made up of a combination of *a priori* and *a posteriori* elements. In cases of this kind we are said, in a general way, to use the Socratic method when we supply the *a posteriori* portion, and by suitable questions lead the child to certain conclusions by *a priori* reasoning. Thus by means of diagrams and descriptions we may give a child the main facts of the earth's motion as a planet, then by working with first principles from this knowledge, get him to answer the question 'at which part of the earth's orbit does the Northern Hemisphere have summer?'

Much of our time in teaching is spent in supplying our pupils with cut and dry judgments, and in leading them to make new judgments for themselves. All school work, therefore, aids in training the judgment, but nothing is so helpful to this end as the practice already so strongly recommended of insisting upon clear and fully expressed definition. Every such definition is a judgment, and the very effort to express it correctly will at the same time impress it upon the memory, and expose any of those mistakes which so often mark judgments hastily formed, and loosely uttered. To the question 'What do you mean by "Squire of dames"?' a boy may answer promptly 'attentive to ladies;' but he is a poor teacher who accepts this explanation. It is true that a squire of dames is "attentive to ladies," and this the boy obviously knows; but it is not the less true that a 'squire' is a man, and of this the boy may be quite ignorant. The accepted answer ought to embody both facts in some such definition as: 'A squire of dames is a man attentive to ladies.' This practice of definition insures careful observation and comparison, which are the two qualities essential in just judgment.

The subjects best suited for the exercise of the judgment and reason are Arithmetic, Geometry, and Grammar. No child can study these subjects without making progress in accurate discrimination and power of continuous thinking. But the teacher may reduce the necessity for thought by introducing rule of thumb methods. Rules in these subjects are necessary to avoid doing the same mental work over and over again, but they should only apply to cases of absolute certainty. For the sake of convenience a teacher may insist upon certain doubtful words being parsed in one way, and may demand a particular method in certain classes of Arithmetical questions, but in general it ought to be a principle that any answer obtained by a rational process and clearly expressed should be accepted. So much work may be given for drill in methods, and so much for the exercise of the reason. In the highest class, alternately with essays for the exercise of the imagination, may be given themes on disputed points, as, 'Which is the more important, the eye or the ear?' 'Is Lying ever Right?' 'The comparative advantages of City and Country Life.' The use of such themes is to train the child to string together *in their natural order* the judgments he has already learnt how to form. A man untrained in such exercises cannot think ten minutes consecutively on any subject. He sits down to think out a subject, but he either wanders to something else or falls asleep. Formal themes obviate this defect, just as clearly expressed definition gets rid of confused judgments.

Though deduction is absolutely sure of its result if the premises be true, these are often so arranged as to produce a result not necessarily true. Such a process is called a fallacy. A fallacy is a process of reasoning in which the conclusion does not follow from the premises. The conclusion may be true, but, if it do not follow logically from the premises the reasoning is fallacious. A common form of fallacy is called 'begging the question' or assuming in the premises what is sought to be proved. 'The Bible must be true for "His testimony is sure."' Here the conclusion is true, but the argument is none the less a fallacy for the argument 'His testimony is true' is only of value if the Bible be true. So 'Truth is always best, for people get on best who tell the truth.' Here we obviously assume that truth is always best when we assert that truth-tellers always get on best. When the reasoning is drawn out a little this fallacy is called 'reasoning in a circle.' 'India was unjustly annexed because it was independent; and an independent nation has an unalienable right to its freedom unless it has forfeited this right by some misdeed. *Since it was unjustly annexed* no such misdeed existed in this case. Therefore our seizure was unjustifiable.' The words in italics indicate the unwarranted assumption.

Another important form of fallacy is that called the 'fallacy of undistributed middle.' In this case we compare the major and minor terms respectively with different parts of the middle term.

All bees are insects.
All flies are insects.
∴ All bees are flies.

Here the term 'insects' is not distributed, that is, it is not taken in its full meaning. One part of it is compared with flies and another part with bees, and we are not entitled to draw any conclusion at all from the premises.

There is a particular form of deductive reasoning called '*reductio ad absurdum*.' It consists in accepting our opponent's position, and showing that it leads to something ridiculous. Suppose that it is maintained that the earth does not rotate. We reason thus: 'Granted. Then all the stars must revolve round the earth every twenty-four hours. But at the enormous distance of these stars from the earth their speed in such a case must be inconceivably rapid, so rapid as to dissipate their matter into space. But they still exist, which is absurd. Therefore the earth must rotate since to suppose otherwise leads to an absurdity.'

Among the many other fallacies there is only one of practical importance to the teacher. It is called the *ignoratio elenchi*, and consists in proving not just the thing required but something very like it. Against this fallacy the teacher should always be on his guard, especially in the exercises and examination papers of his best pupils.

(To be continued.)

OUR SCHOOL.

Con spirito. *mf* Music by T. CRAMPTON.

1st TREBLE.
2nd TREBLE.
BASS.

1. We've come up here for learn-ing and we mean to do our best, To have a school quite
2. Our tasks they may per-plex us and be ra-ther hard and dry, But we are sure of
3. The great-est men in all the world that high-est sta-tions fill, Once work'd in school like

KEY B♭. *Con spirito.* *mf* F.t.

1st TREBLE. 2nd TREBLE. BASS.

e-qual here to a-ny east or west; We've room for much im-prove-ment but will
conq-'ring by the ma-gic words "I'll try;" Our mot-to's "where there is a will there
us to climb great learn-ing's rug-ged hill; Their ho-nours are for com-pe-ti-tion

f. B♭.

in the se-quel show, That our ef-forts have not been in vain, then stu-dy soft and low.
al-ways is a way," And "it is the con-stant drop that wears the hard-est rock a-way."
o-pen to us all, So we'll ga-ther stores of know-ledge that will be of use to all.

CHORUS. *f*

Oh stea-dy on, make no de-lay, learn something ev'-ry day, Learn something ev'-ry day.

CHORUS. *f* *f*

Animal Physiology.

BY ARTHUR NEWSHOLME, M.D., AND C.S.S. (LOND.)

RESPIRATION *(continued)*.

Changes of Blood in Respiration.

The blood which enters and traverses the substance of the lungs is the great mass of venous blood returning from every part of the body, and differs in many important respects from that leaving the lungs, which has a nearly uniform composition, and is the brightest coloured blood in the body.

Difference in Colour.

The difference in colour between the purple blood entering the lungs and the bright scarlet blood leaving them is the most obvious point of distinction. This change of colour is due to the absorption of oxygen by the hæmoglobin of red corpuscles. Even before the discovery of oxygen by Priestley, the change was recognised by several observers as being due to the action of the air. The influence of air in changing the colour of venous blood may be observed even in venous blood removed from the body. If we cut into a clot of blood the interior is almost black, but becomes red a few seconds after exposure to the air. It is the red corpuscles which absorb the greater part of the oxygen. While blood-plasma will absorb about twice as much gas as pure water, according to Gay-Lussac the corpuscles will absorb from ten to thirteen times as much; according to other observers a much higher proportion.

Composition of Gases in Blood.

The chief change in the blood passing through the lungs is in the relative amounts of carbonic acid and oxygen. In the air leaving the lungs oxygen is diminished and carbonic acid increased; and conversely in the blood leaving the lungs, oxygen is increased and carbonic acid diminished.

By means of the mercurial air-pump, 60 volumes of gas can be extracted from 100 volumes of blood, if measured at 0°c and 760 mm. barometric pressure. The composition of the gases thus extracted is given as follows by Dr. M. Foster. There may be obtained from 100 volumes—

	Oxygen.	Carb. Acid.	Nitrogen.
Of arterial blood...	20 vols.	39 vols.	1 to 2 vols.
Of venous blood...	8 to 12 „	46 „	1 to 2 „

Condition of Oxygen in Blood.

The oxygen in blood is not in simple solution, but in a condition of feeble combination with the hæmoglobin of red corpuscles. The absorption of oxygen by blood does not follow the law of absorption according to pressure, as it would do, were it simply a question of solution. Blood which has been deprived of its red corpuscles will absorb but a small quantity of oxygen. It is evident, therefore, that it is the red corpuscles which render the blood competent to absorb a large quantity of oxygen. Hæmoglobin forms about 90 per cent. of the composition of dried red corpuscles, and this is the substance with which the oxygen becomes associated.

Hæmoglobin, when separated from the corpuscles, is readily soluble in water. To separate it from them, it is necessary to break up the corpuscles. This may be effected by adding to a small particle of clotted blood ether, drop by drop. If the jelly-like mass produced be passed through a cloth, crystals soon appear in the liquid, which may be separated by filtration. The crystals obtained with difficulty from human blood are in the form of four-sided prisms, elongated rhomboids, or rectangular tablets (A. Fig. 49). They are composed of carbon, hydrogen, oxygen, nitrogen, and sulphur, with a small quantity of iron. That the iron is a necessary constituent of blood corpuscles, is proved by the fact that in cases of anæmia, *i.e.*, comparative bloodlessness, as manifested by pallor and languor, the medicinal administration of iron is rapidly followed by improved colour and health of the patient.

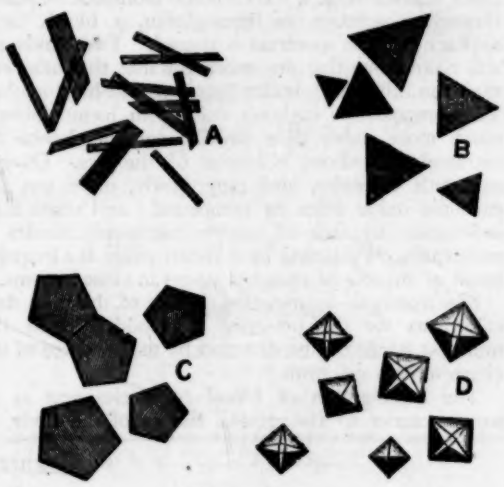

Figure 49.

A. Blood crystals from human blood. B. Trihedral crystals from guinea-pig's blood. C. Pentagonal crystals from squirrel's blood. D. Octahedral crystals from blood of rat or mouse.

The shape of the crystals obtained from blood corpuscles differs in various animals, and by this means one can occasionally detect the source of a given specimen of blood. (See fig. 49).

Spectroscopic examination of Blood.

A dilute aqueous solution of hæmoglobin placed before a spectroscope, is found to absorb certain rays of light in a special and characteristic manner. The most striking feature is the appearance of two strongly marked absorption bands between the lines D. and E. in Frauenhofer's scale. Of these the one towards the red side is the thinnest but darkest; the other is broader and comes nearly close up to the line E. In concentrated solutions these two bands may become fused into one broad band.

When crystals of hæmoglobin are subjected to the vacuum of the mercurial air-pump, they give off a definite amount of oxygen, one gramme of the crystals always giving off 1.76 c.cm of oxygen (M. Foster). This is not the oxygen previously stated to enter into the essential composition of hæmoglobin, but a quantity over and above, which is in loose combination with the hæmoglobin, and can be dissociated from it by a sufficiently low pressure. The crystals thus reduced, have a darker and more purple hue than the original hæmoglobin crystals.

The same deprivation of this loosely combined oxygen may be effected by treating hæmoglobin in solution with a few drops of ammonium sulphide or other reducing agent. The solution at once changes from a bright scarlet to a purplish colour; and when examined by the spectroscope, the solution presents a totally different spectrum from that of the unreduced solution. The two absorption bands have disappeared, and in their place is a broader but fainter band intermediate between the two others. If the solution of reduced hæmoglobin be shaken up in the air for a second or two, the single band disappears, and the two characteristic bands of oxy-hæmoglobin return.

Hæmoglobin combines in a similar way with other gases besides oxygen. If carbonic monoxide be passed through a solution of hæmoglobin, a bluish tinge appears, and the spectrum is altered. Two bands are still visible, but they are more towards the blue end than the otherwise similar bands of oxy-hæmoglobin. The compound of carbonic oxide with hæmoglobin is much more stable than oxy-hæmoglobin; hence the extremely poisonous character of the gas. Oxygen can with difficulty, and only slowly, drive out the carbonic oxide from its compound; and death from suffocation by lack of oxygen commonly occurs in such cases. Poisoning by carbonic oxide is a frequent result of the use of charcoal stoves in closed rooms.

Spectroscopic examination is one of the most delicate tests for the presence of blood. Even the minutest traces can be detected by the presence of the characteristic spectrum.

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Condition of Carbonic Acid in Blood.

While there is every reason to suppose that the oxygen in blood is combined with hæmoglobin, the carbonic acid seems to be in a state of simple solution in the blood plasma. By far the greater part is given off in the mercurial vacuum, only 2 to 5 per cent. requiring the addition of an acid.

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∴ Sum invested at 4½ per cent. = £17 9s. 10½d. × 100
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Sum invested at 3½ per cent. = £3,000 − £1,749 10s.
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∴ Square root = 3,253. Ans.

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Then cost with duty = £125,
Loss = 5% on £125 = £6 5s.,
Gain = 1% ,, ,, = £1 5s.;
Difference between the two prices = £6 5s. + £1 5s. = £7½;

∴ Cost of watch = £100 × $\frac{3}{7\frac{1}{2}}$
= £100 × $\frac{2}{5}$
= £40. Ans.

4. J. GREAVES.—If 1 lb. of metal containing copper and zinc in the ratio of ·84 to ·16 be mixed with 2 lbs. containing the same metals in the ratio of ·75 to ·25, find how much copper and zinc there is in the mixture. (*Jackson.*)

Quantity of copper = ·84 of 1 lb. + ·75 of 2 lbs.
= (·84 + 1·5) lbs.
= 2·34 lbs.
16
oz. 5·44
16
drs. 7·04
= 2 lbs. 5 oz. 7·04 drs.;
,, ,, zinc. = 3 lbs. − 2 lbs. 5oz. 7·04 drs.;
= 10 oz. 8·96 drs.

Note.—Avoirdupois Weight is used for copper and zinc.

5. HAREFOOT.—A person who has £10,257 10s. 3 per cent. stock calculates that, by selling it and investing in 3½ per cent. stock at 93¼, he can increase his annual income by £10 9s.; but before he can effect the exchange, each stock rises ¼ per cent. By how much is his income really increased? (*Capel.*)

Income in first case = 3% on £10,257 10s.
= £307 14s. 6d.;

Increase in income before rise in stocks
= £307 14s. 6d. + £10 9s.
= £318 3s. 6d.;

∴ Amount of 2nd stock before rise

$$= £318\ 3s.\ 6d. \times \frac{100}{3\frac{1}{4}}$$
$$= £318\ 3s.\ 6d. \times \tfrac{400}{13}$$
$$= £24\ 9s.\ 6d. \times 400$$
$$= £9{,}790;$$

$$\therefore \text{Original price of 1st stock} = £93\tfrac{1}{4} \times \frac{9790}{10257\frac{1}{2}}$$
$$= \left(\frac{373}{4} \times \frac{19580}{20515}\right)£$$
$$= £89.$$

£ 93¼ : £ 89¾ } :: £ 10257½ : Income in 2nd case after rise.
£ 100 : £ 3¼ }

$$= \left(\frac{357}{374} \times \frac{13}{80} \times \frac{20515}{2}\right)£$$
$$= \tfrac{1011820}{320}£$$
$$= £318\ 4s.\ 3\tfrac{3}{4}d.$$

∴ Increase in income = £318 4s. 3¾d. − £307 14s. 6d.
= £10 9s. 9¾d. Ans.

Algebra.

1. MAGISTER.—Solve:—

$$\left.\begin{aligned} x(y+z) &= a \\ y(x+z) &= b \\ z(x+y) &= c \end{aligned}\right\} \quad (\textit{Bonnycastle.})$$

$$\left.\begin{aligned} (1)\quad x(y+z) &= a \\ (2)\quad y(x+z) &= b \\ (3)\quad z(x+y) &= c \end{aligned}\right\}$$

$$\left.\begin{aligned} (1)\quad xy + xz &= a \\ (2)\quad xy + yz &= b \end{aligned}\right\}$$

Subtracting] $xz - yz = a - b$
(3) $xz + yz = c$

Adding] $2xz = a - b + c$

$$\therefore xz = \frac{a-b+c}{2}. \quad (4)$$

$$(1)\qquad xy = a - \frac{a-b+c}{2}$$
$$= \frac{a+b-c}{2}. \quad (5)$$

$$(3)\qquad yz = c - \frac{a-b+c}{2}$$
$$= \frac{b+c-a}{2}. \quad (6)$$

(4) × (5)] $$x^2yz = \frac{a+c-b}{2} \times \frac{a+b-c}{2}$$

$$x^2 = \frac{(a+c-b)(a+b-c)}{4} \times \frac{2}{b+c-a}$$
$$= \frac{(a+c-b)(a+b-c)}{2(b+c-a)}$$
$$\therefore x = \pm \left\{\frac{(a+c-b)(a+b-c)}{2(b+c-a)}\right\}^{\frac{1}{2}}.$$

(5) × (6)] $$y^2xz = \frac{a+b-c}{2} \times \frac{b+c-a}{2}$$

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$$\therefore z = \pm \left\{\frac{(a+c-b)(b+c-a)}{2(a+b-c)}\right\}^{\frac{1}{2}}.$$

2. R. FISH.—A person going at the rate of a miles per hour finds himself b hours too late, when he has c miles farther to go. How much must he increase his speed to reach home in time? (*Atkins.*)

Let x = Increase in miles per hour;

Then, $$\frac{c}{a+x} = \frac{c}{a} - b$$
$$= \frac{c-ab}{a}$$
$$\frac{a+x}{c} = \frac{a}{c-ab}$$
$$a + x = \frac{ac}{c-ab}$$
$$\therefore x = \frac{ac}{c-ab} - a$$
$$= \frac{ac - ac + a^2b}{c-ab}$$
$$= \frac{a^2b}{c-ab}.$$

∴ He must increase his speed $\frac{a^2b}{c-ab}$ miles per hour.

3. MARK TWAIN.—A and B take shares in a concern to the amount altogether of £500. They sell out at par, A at the end of two years, B of eight, and each receives in capital and profit £297. How much did each embark? (*Colenso.*)

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$$= £24\ 9s.\ 6d. \times 400$$
$$= £9{,}790;$$

$$\therefore \text{Original price of 1st stock} = £93\tfrac{1}{4} \times \frac{9790}{10257\frac{1}{2}}$$
$$= \left(\frac{373}{4} \times \frac{\overset{89}{\overset{4895}{9790}}}{\underset{55}{\underset{205\,15}{20515}}}\right)£$$
$$= £89.$$

£ 93¼ : £ 89¼
£ 100 : £ 3¼
} :: £10257½ : Income in 2nd case after rise.

$$= \left(\frac{\overset{21}{357} \times 13 \times \overset{373}{\overset{1865}{205\,15}}}{\underset{2}{\underset{34}{374}} \times \underset{80}{400} \times 2}\right)£$$
$$= \frac{1018320}{320}£$$
$$= £318\ 4s.\ 3\tfrac{3}{4}d.$$

∴ Increase in income = £318 4s. 3¾d. − £307 14s. 6d.
= £10 9s. 9¾d. Ans.

Algebra.

1. MAGISTER.—Solve:—

$$\left.\begin{aligned} x(y+z) &= a \\ y(x+z) &= b \\ z(x+y) &= c \end{aligned}\right\} \quad (\textit{Bonnycastle.})$$

$$\left.\begin{aligned} &(1)\ x(y+z) = a \\ &(2)\ y(x+z) = b \\ &(3)\ z(x+y) = c \end{aligned}\right\}$$

$$\left.\begin{aligned} &(1)\ xy + xz = a \\ &(2)\ xy + yz = b \end{aligned}\right\}$$

Subtracting] $xz - yz = a - b$
(3) $xz + yz = c$

Adding] $2xz = a - b + c$

$$\therefore xz = \frac{a-b+c}{2}. \quad (4)$$

(1) $$xy = a - \frac{a-b+c}{2}$$
$$= \frac{a+b-c}{2}. \quad (5)$$

(3) $$yz = c - \frac{a-b+c}{2}$$
$$= \frac{b+c-a}{2}. \quad (6)$$

(4) × (5)] $$x^2yz = \frac{a+c-b}{2} \times \frac{a+b-c}{2}$$
$$x^2 = \frac{(a+c-b)(a+b-c)}{4} \times \frac{2}{b+c-a}$$
$$= \frac{(a+c-b)(a+b-c)}{2(b+c-a)}$$
$$\therefore x = \pm\left\{\frac{(a+c-b)(a+b-c)}{2(b+c-a)}\right\}^{\frac{1}{2}}.$$

(5) × (6)] $$y^2xz = \frac{a+b-c}{2} \times \frac{b+c-a}{2}$$
$$y^2 = \frac{(a+b-c)(b+c-a)}{4} \times \frac{2}{a+c-b}$$
$$= \frac{(a+b-c)(b+c-a)}{2(a+c-b)}$$
$$\therefore y = \pm\left\{\frac{(a+b-c)(b+c-a)}{2(a+c-b)}\right\}^{\frac{1}{2}}.$$

(4) × (6)] $$z^2xy = \frac{a+c-b}{2} \times \frac{b+c-a}{2}$$
$$z^2 = \frac{(a+c-b)(b+c-a)}{4} \times \frac{2}{a+b-c}$$
$$= \frac{(a+c-b)(b+c-a)}{2(a+b-c)}$$
$$\therefore z = \pm\left\{\frac{(a+c-b)(b+c-a)}{2(a+b-c)}\right\}^{\frac{1}{2}}.$$

2. R. FISH.—A person going at the rate of a miles per hour finds himself b hours too late, when he has c miles farther to go. How much must he increase his speed to reach home in time? (*Atkins.*)

Let x = Increase in miles per hour;

Then, $$\frac{c}{a+x} = \frac{c}{a} - b$$
$$= \frac{c-ab}{a}$$
$$\frac{a+x}{c} = \frac{a}{c-ab}$$
$$a + x = \frac{ac}{c-ab}$$
$$\therefore x = \frac{ac}{c-ab} - a$$
$$= \frac{ac - ac + a^2b}{c-ab}$$
$$= \frac{a^2b}{c-ab}.$$

∴ He must increase his speed $\frac{a^2b}{c-ab}$ miles per hour.

3. MARK TWAIN.—A and B take shares in a concern to the amount altogether of £500. They sell out at par, A at the end of two years, B of eight, and each receives in capital and profit £297. How much did each embark? (*Colenso.*)

Let x = Amount in pounds invested by A,

And ,, y = Rate of profit per cent. per annum in pounds;

Then, (1) $x + \frac{2xy}{100} = 297$

(2) $(500 - x) + \frac{8y(500 - x)}{100} = 297$

(1) $x + \frac{xy}{50} = 297$

(2) $-x + 40y - \frac{4xy}{50} = -203$

(1) $4x + \frac{4xy}{50} = 1188$

(2) $-x + 40y - \frac{4xy}{50} = -203$

Adding] $3x + 40y = 985$

$40y = 985 - 3x$

$\therefore \quad y = \frac{985 - 3x}{40}$.

(1) $x + \frac{xy}{50} = 297$

$x + \left(\frac{985 - 3x}{40} \times \frac{x}{50}\right) = 297$

$2{,}000x + 985x - 3x^2 = 594{,}000$

$-3x^2 + 2{,}985x = 594{,}000$

$x^2 - 995x = -198{,}000$

$x^2 - 995x + \left(\frac{995}{2}\right)^2 = \frac{990{,}025}{4} - 198{,}000$

$= \frac{990{,}025 - 792{,}000}{4}$

$= \frac{198{,}025}{4}$

$x - \frac{995}{2} = \pm \frac{445}{2}$

$x = \pm \frac{445}{2} + \frac{995}{2}$

$\therefore x = 720$, or 275.

$\therefore$ Amount invested by A = £275.

,, ,, B = £225.

4. PULTENEY STREET.—Show that the coefficient of the middle term of $(a + x)^{4n+2}$ is

$$2^{2n+1} \times \frac{(2n+3)(2n+5)\ldots\ldots(4n-1)(4n+1)}{1.2\ldots\ldots n}$$

(Hamblin Smith.)

Coefficient of middle term

$$= \frac{\lfloor 4n+2}{\lfloor 2n+1 \;\; \lfloor 2n+1};$$

Now, $\lfloor 4n+2$

$= 1.2.3\ldots\ldots(2n+1) \times (2n+2)(2n+3)(2n+4)(2n+5)\ldots\ldots$
$(4n-1) \times 4n \times (4n+1)(4n+2)$

$= \lfloor 2n+1 \times (2n+3)(2n+5)\ldots\ldots(4n-1)(4n+1)$
$\times (2n+2)(2n+4)\ldots\ldots(4n+2)$

$= \lfloor 2n+1 \times (2n+3)(2n+5)\ldots\ldots(4n-1)(4n+1)$
$\times 2(n+1) \times 2(n+2)\ldots\ldots 2(2n+1)$

$= \lfloor 2n+1 \times (2n+3)(2n+5)\ldots\ldots(4n-1)(4n+1)$
$\times 2^{n+1}(n+1)(n+2)\ldots\ldots(2n+1)$;

$\therefore$ Coefficient of middle term

$$= 2^{n+1} \times \frac{(2n+3)(2n+5)\ldots(4n-1)(4n+1) \times (n+1)(n+2)\ldots(2n+1)}{\lfloor 2n+1}$$

$$= 2^{n+1} \times \frac{(2n+3)(2n+5)\ldots(4n-1)(4n+1) \times (n+1)(n+2)\ldots(2n+1)}{1.2\ldots n \times (n+1)(n+2)\ldots(2n+1)}$$

$$= 2^{n+1} \times \frac{(2n+3)(2n+5)\ldots(4n-1)(4n+1)}{1.2\ldots n}$$ Ans.

5. PRECEPTRESS.—Solve :—

$$\sqrt{x+10} + \sqrt{x-10} = \frac{60}{\sqrt{x+10}}.$$

(Certificate, 1885.)

$$\sqrt{x+10} + \sqrt{x-10} = \frac{60}{\sqrt{x+10}}$$

$$x + 10 + \sqrt{(x-10)(x+10)} = 60$$

$$\sqrt{x^2 - 100} = 50 - x$$

Squaring each side] $x^2 - 100 = 2500 - 100x + x^2$

$100x = 2500 + 100$

$= 2600$

$\therefore \quad x = 26$.

6. ARTHUR.—Simplify $\left(\frac{x^3-1}{x-1}\right)^2 - \left(\frac{x^3+1}{x+1}\right)^2$, and find its numerical value when $x\sqrt{(2+\sqrt{3})} = 1$.

(Science and Art, 1886.)

$$\left(\frac{x^3-1}{x-1}\right)^2 - \left(\frac{x^3+1}{x+1}\right)^2$$

$= (x^4 + x^3 + x^2 + x + 1)^2 - (x^4 - x^3 + x^2 - x + 1)^2$

$= [(x^4 + x^3 + x^2 + x + 1) + (x^4 - x^3 + x^2 - x + 1)]$
$[(x^4 + x^3 + x^2 + x + 1) - (x^4 - x^3 + x^2 - x + 1)]$

$= (2x^4 + 2x^2 + 2)(2x^3 + 2x)$

$= 4x(x^2 + 1)(x^4 + x^2 + 1)$

$= 4x(x^6 + 2x^4 + 2x^2 + 1)$. Ans.

$x = \frac{1}{\sqrt{2+\sqrt{3}}}$;

$x^2 = \frac{1}{2+\sqrt{3}} = \frac{2-\sqrt{3}}{(2+\sqrt{3})(2-\sqrt{3})} = 2 - \sqrt{3}$;

$x^4 = (2-\sqrt{3})^2 = 4 - 4\sqrt{3} + 3 = 7 - 4\sqrt{3}$;

$\therefore$ Numerical value $= \frac{4}{\sqrt{2+\sqrt{3}}}\left[(2-\sqrt{3}) + 1\right]$
$[(7 - 4\sqrt{3}) + (2 - \sqrt{3}) + 1]$

$= \frac{4}{\sqrt{2+\sqrt{3}}}(3 - \sqrt{3})(10 - 5\sqrt{3})$

$= \frac{4}{\sqrt{2+\sqrt{3}}}(45 - 25\sqrt{3})$

$= \frac{180 - 100\sqrt{3}}{\sqrt{2+\sqrt{3}}}$

$= \frac{180 - (100 \times 1{\cdot}73205\ldots)}{\sqrt{2 + 1{\cdot}73205}}$

$= \frac{180 - 173{\cdot}205\ldots}{\sqrt{3{\cdot}73205\ldots}}$

$= \frac{6{\cdot}795}{1{\cdot}932}$

$= 3{\cdot}5119\ldots$ Ans.

7. PRECEPTRESS.—Solve :—

$x^2 - xy = 20$
$x^2 + y^2 = 26$ *(Certificate, 1885.)*

(1) $x^2 - xy = 20$
(2) $x^2 + y^2 = 26$

(1) $x^2 - xy = 20$

$-xy = 20 - x^2$

$\therefore \quad y = \frac{x^2 - 20}{x}$

$= x - \frac{20}{x}$.

(2) $x^2 + y^2 = 26$

$$x^2 + \left(x - \frac{20}{x}\right)^2 = 26$$

$$x^2 + x^2 - 40 + \frac{400}{x^2} = 26$$

$$2x^2 - 66 = -\frac{400}{x^2}$$

$$x^2 - 33 = -\frac{200}{x^2}$$

$$x^4 - 33x^2 = -200$$

$$x^4 - 33x^2 + (\tfrac{33}{2})^2 = \tfrac{1089}{4} - 200$$

$$= \tfrac{289}{4}$$

$$x^2 - \tfrac{33}{2} = \pm \tfrac{17}{2}$$

$$x^2 = \pm \tfrac{17}{2} + \tfrac{33}{2}$$

$$= 25 \text{ or } 8$$

$$\therefore x = \pm 5, \text{ or } \pm 2\sqrt{2}.$$

$$\therefore y = \frac{x^2 - 20}{x}$$

$$= \frac{25 - 20}{\pm 5}, \text{ or } \frac{8 - 20}{\pm 2\sqrt{2}}$$

$$= \frac{5}{\pm 5}, \text{ or } \frac{-12}{\pm 2\sqrt{2}}$$

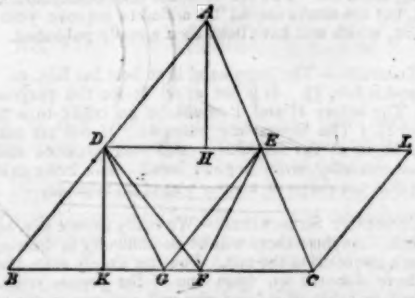
$$= \pm 1, \text{ or } \mp \frac{6}{\sqrt{2}}$$

$$= \pm 1, \text{ or } \mp 3\sqrt{2}.$$

$$\therefore \left.\begin{matrix} x = \pm 5, \text{ or } \pm 2\sqrt{2} \\ y = \pm 1, \text{ or } \mp 3\sqrt{2} \end{matrix}\right\}$$

Geometry.

1. D. WILLIAMS.—When the corner of the leaf of a book is turned down a second time, so that the lines of folding are parallel and equidistant, the space in the second fold is equal to three times that in the first. (*Potts.*)



Let ABC represent the corner of a leaf of a book, of which A is the corner, DE, BC the equidistant and parallel foldings, and DFE the folding of ADE.

Then the figure DBCE shall be equal to three times the triangle ADE, or DFE.

Bisect BC in the point G, and join DG, EG.

Draw AH, DK perpendicular to DE, BC, respectively.

Produce DE to L, and through C draw CL parallel to AB.

PROOF.—In the triangles ADH, DBK,

Because $\angle$ ADH = $\angle$ DBK (I. 29.)
$\angle$ AHD = $\angle$ DKB (Ax 11.)
and side AH = side DK (Hyp.)
$\therefore$ side AD = side DB (I. 26.)

Similarly it can be proved that AE = EC.

Again, in the triangles ADE, CLE,

Because $\angle$ ADE = $\angle$ CLE (I. 29.)
$\angle$ AED = $\angle$ CEL (I. 15.)
and side AE = side CE,
$\therefore$ side DE = side EL (I. 26.)

Now DBCL is a parallelogram, and sides DL, BC are bisected;

$\therefore$ DBGE, EGCL are equal parallelograms;

Parallelogram DBGE is double of the triangle DGE, and triangle GEC is equal to the triangle DGE,

$\therefore$ Figure DBCE = 3 times $\triangle$ DGE;
But $\triangle$ DGE = $\triangle$ DFE (I. 37.)
And $\triangle$ DFE = $\triangle$ ADE (Hyp.)
$\therefore$ Figure DBCE = 3 times $\triangle$ ADE.

Q.E.D.

Mensuration.

1. A CONTRIBUTOR.—A cubical block of wood is put into a lathe and turned into a sphere with the least possible waste of material; compare the weights of the wood before and after it was turned. (*Certificate*, 1885.)

Weight of cubical block : Weight of sphere
:: 1^3 : $1^3 \times \cdot5236$,
:: 1 : $\cdot5236$,
:: 10000 : 5236,
:: 2500 : 1309. Ans.

2. MENSURO.—The area of the whole surface of a right circular cone is 32 sq. ft., and the slant height is three times the radius of the base; find the volume of the cone. (*Todhunter.*)

Whole surface = Area of base + Convex surface;

$\therefore$ 32 sq. ft. = (Radius$^2 \times 3{\cdot}1416$) + ($\frac{1}{2}$ Perimeter of base × Slant height)
$= (r^2 \times 3{\cdot}1416) + (\frac{1}{2} \times 2r \times 3{\cdot}1416 \times 3r)$
$= (r^2 \times 3{\cdot}1416) + (r^2 \times 3{\cdot}1416 \times 3)$
$= r^2 \times 3{\cdot}1416 \times 4$
8 sq. ft. $= r^2 \times 3{\cdot}1416$

$$r^2 = \frac{8}{3{\cdot}1416} \text{ sq. ft.}$$

$$= \frac{1}{{\cdot}3927} \text{ sq. ft.}$$

$$\therefore r = \frac{1}{\sqrt{{\cdot}3927}} \text{ ft.}$$

Height^2 = Slant height^2 − Radius^2
$= (3r)^2 - r^2$
$= 9r^2 - r^2$
$= 8r^2$

$$= \frac{8}{{\cdot}3927} \text{ sq. ft.}$$

$$\therefore \text{Height} = \sqrt{\frac{8}{{\cdot}3927}} \text{ ft.}$$

Volume of cone = $\frac{1}{3}$ Area of base × Height

$$= \left(\tfrac{1}{3} \times \frac{1}{{\cdot}3927} \times \frac{8}{3{\cdot}1416} \times \sqrt{\frac{8}{{\cdot}3927}}\right) \text{cub. ft.}$$

$$= \left(\tfrac{1}{3} \times \sqrt{\frac{8}{{\cdot}3927}}\right) \text{cub. ft.}$$

$$= \sqrt{\frac{8 \times 64}{{\cdot}3927 \times 9}} \text{ cub. ft.}$$

$$= \sqrt{\frac{512}{3{\cdot}5343}} \text{ cub. ft.}$$

$= 3{\cdot}5343)512{\cdot}00(144{\cdot}866027$

35343
158570
141372
171980
141372
306080
282744
233360
212058
213020
212058
96200
70686
255140
247401
7739

$144{\cdot}866027(12{\cdot}036$

144

2403	8660
	7209
24066	145127
	144396
	731

∴ Volume of cone = 12·036... cub. ft. Ans.

General.

1. MOLESTUM.—The G.C.M. of the expressions given can *only* be found by Factors. The query appeared in our issue for January, 1885.

2. HUDDERSFILD.—The solution of your query appeared in our issue for June, 1886.

3. ENQUIRER.—It is not quite possible to answer your question. There are such wide differences in human endowment. Broadly speaking, we should say No. But you can do much. For freehand use the copies of any of the great publishing houses for Grades I. and II. For Geometry and Perspective you can try *Yule's* Manuals. *Forsyth's* 'Perspective,' is highly thought of.

4. E. J. BARRETT.—We cannot say. Most likely not. You are aware of what is implied in that. You will do well to continue your studies and prepare for the examination.

5. K. J. A.—The small hand is legible and neat; some of the letters are well formed; the large hand shows promise, but there is great want of uniformity in it; it would not bear examination. The initials at the bottom are the best part of the performance. If you are in earnest you will succeed in writing well in time; 65; 60.

6. READER FROM THE BEGINNING.—If you have read the Query Column for the last six months you will have found nearly all you want. There is no virtue in being self-taught, and if you can get any help you will be a great gainer, and save much time and energy. *Fowne's* 'Manual of Chemistry' will suit you—last edition. As you have no teacher *Bloxam's* large treatise on Chemistry would be very serviceable, as the practical instructions are very complete. For the analysis *Fenton's* Tables would do, or *Clowes'* 'Practical Chemistry' which is an excellent book. For the Biology you must use *Huxley and Martin's* 'Manual.' But that does not now contain all you want. Perhaps ere long there will be some manual that will cover the ground; begin with Huxley's book, omitting anything not contained in the last syllabus for the course. For the Physics you could hardly do better than study *Deschanel*, edited by Dr. Everett (last edition). Use in connection with it, either *Glazebrook's* 'Practical Physics,' or *Stewart's* smaller 'Treatise on Practical Physics' (if it is out in time). You will find the things you ask for can be bought at Becker's, 17, Maiden-lane, Strand.

7. NICODEMUS.—Chemical actions are by no means so simple as they were once thought to be. The main points to be noted in the question you quote are these:—

Concentrated sulphuric acid and common salt react at a high temperature according to the equation:

$2\,NaCl + H_2SO_4 = 2\,HCl + Na_2SO_4$, at a low temperature, and in the cold the reaction is expressed thus:—

$$NaCl + H_2SO_4 = NaHSO_4 + HCl.$$

Dilute acid does not disengage HCl.

Chemically pure zinc is scarcely, if at all, acted upon by sulphuric acid. Commercial zinc is however never pure.

Dilute sulphuric acid, both cold and hot, and zinc, yield zinc sulphate and hydrogen.

$$H_2SO_4 + Zn = H_2 + ZnSO_4.$$

If strong H_2SO_4 be added while the hydrogen is being evolved some of it will be reduced by the nascent H_2 and a mixture of H_2 and SH_2 be given off.

Concentrated sulphuric acid, even when hot, has no action on zinc, possibly on account of the sulphate being insoluble in H_2SO_4, and thus incrusting the metal.

Copper is not attacked by hot or cold dilute sulphuric acid, nor by concentrated acid when it is cold; but when hot the acid is reduced according to the equation:

$$2H_2SO_4 + Cu = CuSO_4 + SO_2 + 2OH_2.$$

Dilute solutions of H_2SO_4 have no effect upon nitre. Concentrated acid and a gentle heat liberate nitric acid which distils over.

$$H_2SO_4 + KNO_3 = HKSO_4 + HNO_3.$$

At a higher temperature the action takes place according to the formula—

$$H_2SO_4 + 2KNO_3 = K_2SO_4 + 2HNO_3.$$

Dilute acid has no action on oxalic acid. Strong acid, when hot, removes the water of crystallization, and one molecule of water besides from each molecule of oxalic acid. The residue breaks up according to the equation:

$$\left.\begin{matrix}CO.OH\\CO.OH\end{matrix}\right\} = H_2O + CO_2 + CO.$$

or $H_2C_2O_4.\,2aq + H_2SO_4 = CO_2 + CO + H_2SO_4.\,3aq.$

8. W. S.—Certainly. They will be sent post free for 1s. 9d., or you can order them through your bookseller.

9. HOMO.—The large hand is pretty good. What you really need is a few weeks' careful practice of good models. The smaller writing is better, but is a little too stiff and upright. Large 65, small 80. You can no doubt take blackboard as you suggest, but the marks cannot be added to improve your place on the list, which will have been then already published.

10. TRAWETS.—The large hand is at best but fair, 50. The small hand is fair, 55. It is not at all fit for the purpose you name. The letters H and P would be no credit to a boy in Standard II. The figures are passable. If you are really in earnest, begin at the beginning, and with patience and perseverance you may write a good hand. You have evidently thought that the shape of a letter was of no moment.

11. CONSTANT SUBSCRIBER.—We really cannot say, but you may do so. Anyhow there will be no difficulty in drawing the examiner's attention to the fact. You can simply state the fact, as you have done to us, upon one of the papers you fill up. Notice will be taken of it, and you will get any credit that is due to you.

12. HET.—Read Rule II. of the Query Column. Send your address and name and your query will be answered.

13. ANXIOUS.—Buy the publication called the 'Civil Service Candidate,' or write to the gentlemen who advertise in this magazine.

14. LECTURER.—By far the easiest and cheapest way, in our opinion, would be to consult a good Cyclopædia or two at a public library. Turn, for instance, to the article Balloon, in the 'Encyclopædia Britannica.'

15. L. M. N.—There is no book needing special commendation. *Mackay's* Geography will be quite sufficient. A teacher who is often supposed to know his subject thoroughly might profitably read the articles on the separate counties in the 'Encyclopædia Britannica.'

16. YORKSHIRE.—The publisher's name is Macmillan and Co. It is a useful little book, but you will hardly be able to use it as the author intended. 2. We don't know; write to the publisher. 3. Do you mean the *form* or the *meaning*. You will find both distinguished in any good grammar. 4. There are no rules; learn the cases as they occur, and try to fix a phrase in your memory.

17. DAVID WILLIAMS.—Write to the publisher and state your circumstances; perhaps he will send you one; the price is 1s. You should get Part II., and work at the two together as advised in the preface. You will then be able to answer the last question yourself in due time.

18. E. SMITH.—We will make enquiries for you and inform you next month of the result.

19. SEWIG.—You should write out your questions neatly, and punctuate them.

The analysis is quite easy; it consists of two principal sentences:—

(1) Thou, subject (understood); tell, predicate; John, object; to come, indirect object; here, extension.

(2) Thou, subject (understood); let, predicate; me, object; (to) see, object; him, object of *to see*.

Parsing:

To come—irreg. intrans. verb, present tense, infinitive mood, used as indirect object of verb tell. This is the gerundial infinitive.

see—irreg. trans. verb, present tense, infinitive mood, gov. by verb '*let*.'

him—personal pronoun, 3rd pers., mas. gen., sing. number, objective case, gov. by '*see*.'

20. SEMINARIUM.—Your suggestion will be considered. Thank you.

—o—

Lectures on Shakspere's 'King Lear.'

BY H. MARMADUKE HEWITT, M.A., LL.M.,

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No. VII. Act III., Scenes 3, 4, 5, 6, 7.

Scene 3.

THERE is not much difficulty in the expression *revenged home* (line 11). The same use of the word occurs again in Sc. 4, 16, '*I will punish home*.' The sword that is *driven home* is forced to its destination, driven some considerable distance into an adversary's flesh. *Revenged home*, then, may mean 'revenged to the full,' and *I will punish home* is probably equivalent to 'I will exact a very complete punishment.' *There is part of a power already footed* (11) means 'there is part of an army that has already taken the field.' *Power* for *force* or *army* is by no means uncommon. *That my charity be not of him perceived* is easily made intelligible by substituting for the last three words *perceived by him*. Shakspere's use of prepositions is a remarkable characteristic of his writings, and here, of course, he employs *of* for *by*. *Some strange thing toward* (17) means 'some strange thing at hand,' or strange thing that is about to happen. In Act II., Sc. 1, 10 we had the expression *wars toward*=wars in preparation or in contemplation. This use of the word *toward (to-weard)* is as old as the Anglo-Saxon period. It is seen in the expression *on toweardre worulde*='in the world to come,' in which of course it appears as an adjective.

Old Gloucester having resolved to aid the King in his distress, his treacherous son is fully determined that the duke shall be made acquainted with his intention. *This courtesy forbid thee* means 'this act of courtesy (*i. e.*, assisting Lear) which you were forbidden to perform,' for *forbid thee* is equivalent to *forbidden thee* (Lat. *tibi interdictum*). The whole sentence is inverted, the logical order being '*The duke shall instantly know this courtesy, &c.*' The treacherous Edmund actually does accuse his own father, with what dreadful results we shall see before this Act is ended. He is anticipating the reward of his perfidy. *This seems a fair deserving* (21), probably means 'This, *i. e.*, my informing of my father, seems a meritorious performance; *it must draw me* (he soliloquises) *that which my father loses*,' *i. e.*, 'it must bring me his forfeited title and estates. This perfidy of Edmund is one of the most revolting incidents of the tragedy. It is somewhat mitigated, however, by the reflection that Edmund, on account of the circumstances of his birth, had received only a scanty measure of kindness from his father, who could find nothing better to say of him than 'I have so often blushed to acknowledge him that now I am brazed to it' (Act I., Sc. 1, lines 8, 9).

Scene 4.

In the Fourth Scene we meet Lear, *Kent*, and the Fool, all out together on the heath, exposed to the fury of the pitiless storm. As the old man's mind is still brooding over his wrongs he is callous, naturally enough, to mere external inconveniences.

Sentiments like the following are perhaps a little commonplace:—

'*But where the greater malady is fixed*
The lesser is scarce felt.'

And—

'*When the mind is free*
The body's delicate.'

A man who is grieving over his children's ingratitude may well be indifferent to such a trifling inconvenience as a wetting, and probably it is when the mind is free from serious trouble that men are most sensitive to smaller annoyances.

As, for *as if*, appears in the passage—

'Is it not *as* this mouth should tear this hand
For lifting food to it?' (15, 16).

As regards the force of *that way* in—

'O that way madness lies' (21).

We may consider Lear as stating that madness would be the result of brooding over his ill-treatment.

On things would hurt me more (25) is an instance of the omission of the relative. Understand *that* before *would*. What a striking description of a beggar's torn suit is '*looped and windowed raggedness*.' This expression implies that portions of his uncovered skin were peeping out through the holes in his garments. The sight of another's misery seems to have wakened a touch of remorse in the old king's heart, since we find him exclaiming '*O, I have ta'en too little care of this*.' He accuses himself, now that misery has overtaken him, of previous indifference to the misfortunes of others.

A favourite quotation is—

'*Take physic, pomp,*
Expose thyself to feel what wretches feel,
That thou mayst shake the superflux to them
And show the heavens more just.'

After all, though, his moralising does not go very far. When pomp has 'taken physic,' all that it can be expected to do, Lear seems to think, is to throw a few crumbs, or, as the poet has it, '*the superflux*' to the unfortunate. The unfortunate have little to hope from the generosity of their fellow creatures, as long as they trust to that alone. When they begin to make themselves disagreeable their wants are more likely to receive attention.

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In the enumeration of his sufferings the poor maniac describes himself as '*whipped from tything to tything*,' and '*stocked, punished, and imprisoned*.' We have already spoken of the brutality of the laws during Henry the Eighth's reign when mendicity was treated as a crime of the first magnitude. Castigation for mendicancy, that is for being poor, must have been at one time a common spectacle. It is difficult to conceive the callousness and indifference to human suffering that have characterised society at certain epochs, and of all forms of cruelty that which is manifested towards the mentally afflicted is, to us, the most shocking and detestable. There are indeed many dark chapters in the history of the human race, and the study of the past suggests many painful thoughts. It is some consolation to think that with all its faults and shortcomings, ours is on the whole a merciful age.

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'*I'll never care what wickedness I do*,' says the second serving-man, '*if this man come to good*.' As Shakspere has delineated well nigh every feeling of the human heart, it would have been strange indeed, if he had overlooked a sentiment like this. The desire to see good triumphant in the present life is one of the deepest longings of all noble souls, and nothing can be more painful than the conviction, or even the suspicion, of the indifference of nature to the moral doings of our race. Here, as in other things, we find Shakspere saying for us what we could not have failed to say for ourselves.

(To be continued.)

Recent Inspection Questions.

Arithmetic.

STANDARD I.

A.

(1) 63, 8, 756, 82, 964 = 1,873. Ans.

(2) 875, 28 = 847. Ans.

(3) 736, 219 = 517. Ans.

B.

(1) 87, 6, 962, 74, 832 = 1,961. Ans.

(2) 768, 39 = 729. Ans.

(3) 824, 316 = 508. Ans.

STANDARD II.

A.

1. From 75,021 take 9,106. 65,915. Ans.
2. Divide 95,112 by 8. 11,889. Ans.
3. Multiply 7,829 by 460. 3,601,340. Ans.

B.

1. From 69,014 take 7,031. 61,983. Ans.
2. Divide 76,516 by 9. $8,501\frac{7}{9}$. Ans.
3. Multiply 8,647 by 580. 5,015,260. Ans.

STANDARD III.

A.

1. A man had a million bricks and he built twenty-five houses, each house taking 38,600 bricks. How many bricks were left?

1,000,000 − (38,600 × 25) = 35,000. Ans.

2. A sofa cost £3 10s. 6d., and six chairs cost £5. How much change would be left out of £10.

£10 − (£3 10s. 6d. + £5) = £1 9s. 6d. Ans.

3. Divide 534,074 by 39.

$13,694\frac{8}{39}$. Ans.

4. Add £36,071 10s. 9½d., £7 19s. 6½d., £42 17s. 9½d., £5,372 18s. 7d., £54 0s. 3½d.

£41,549 6s. 11¾d. Ans.

B.

1. Take £500 17s. 10d. from £24,305 0s. 11½d.

£23,804 3s. 1½d. Ans.

2. If I buy two dozen boxes of marbles, each containing twelve marbles, and divide them equally among eighteen boys, how many will each boy receive?

(12 × 24) ÷ 18 = 16. Ans.

3. I spent 39 threepenny pieces and forty shillings, how much change shall I have out of a ten-pound note?

£10 − (40s. + 39 × 3d.) = £7 10s. 3d. Ans.

4. Add together £40,009 11s. 7d., £16 19s. 11¾d. £73 14s. 2¼d., £4,004 4s. 9d., £237 0s. 10½d.

£44,341 11s. 4¼d. Ans.

STANDARD IV.

A.

1. Reduce 21 tons 18 lbs. 11 ozs. to ozs.

752,939 ozs. Ans.

2. Multiply £84 12s. 9½d. by 90.

£7,617 11s. 3d. Ans.

3. Divide £8 11s. 10¼d. by 840.

$2\frac{1}{4}$d. $\frac{689}{840}$. Ans.

4. How many steps will a boy take to walk to school if he has to go two and a half miles, and each step he takes is 18 inches long?

$2\frac{1}{2}$ miles ÷ 18 in. = 8,800 steps.

B.

1. Multiply £994 10s. 1¼d. by 908.

£903,010 14s. 7d. Ans.

2. In 7 fur., 3 poles, 5 yds., 1 ft. How many inches?

56,226 inches. Ans.

3. I bought a ton of sugar for £38. Fifty pounds of it were wasted and 15 pounds spoiled. The rest was sold at 5d. a pound. How much did I gain?

2,240 − (50 + 15) = 2,175 lbs.

2,175 @ 5d. = 10,875d. = £45 6s. 3d.

£45 6s. 3d. − £38 = £7 6s. 3d. Ans.

4. Divide £41,660 by 53.

£786 0s. $9\frac{3}{53}$d. Ans.

STANDARD V.

A.

1. If a wine dealer sells 500 gallons of wine to a customer at 9s. 9d. per gallon, and the buyer becomes a bankrupt and pays only 2s. 6d. in the pound, how much does the dealer receive?

(9s. 9d. × 500) $\frac{1}{8}$ = £30 9s. 4½d. Ans.

2. Find by practice the cost of 40 cwt. at £13 16s. 11½d. per cwt.

£553 18s. 4d. Ans.

3. I spent one-half of my money and lost one-fifth, and the rest I gave away: What fraction did I give away?

$1 - (\frac{1}{2} + \frac{1}{5}) = \frac{3}{10}$. Ans.

4. If 670 articles cost £3 4s. 7½d., what will 800 cost?

670 : 800 :: £3 4s. 7½d. : £3 17s. $1\frac{6}{67}$d. Ans.

B.

1. Make out the following bill: 3 doz. eggs @ 11d. per doz.; 3 turkeys at 3s. 11d. each; 7 gallons of milk @ 2d. per pint; 8 ducks at 2s. each.

(2s. 9d. + 11s. 9d. + 9s. 4d. + 16s.)
= £1 19s. 10d. Ans.

2. 555 cwts. are carried a certain distance for £3 12s. 11d. What will 315 cwts. cost to be carried the same distance?

555 : 315 :: £3 12s. 11d. : £2 1s. $4\frac{2}{37}$d. Ans.

3. Take $\frac{3}{4} - \frac{5}{8}$ from $\frac{7}{9}$

$\frac{7}{9} - (\frac{3}{4} - \frac{5}{8}) = \frac{47}{72}$. Ans.

4. Find the cost of 1508 yds. at 11¾d. per yd.

£73 16s. 7d. Ans.

STANDARD VI.

A.

1. Find the amount of £356 12s. 6d. for 10 years at 5 per cent.

£356 12s. 6d. + £178 6s. 3d.
= £534 18s. 9d. Ans.

2. Divide the sum of 4·71 and ·375 by the difference between ·0331 and ·6331.

(4·71 + ·375) ÷ (·6331 − ·0331)
= 8·475. Ans.

3. Reduce $\frac{\frac{3}{5} \times \frac{1}{4} + \frac{1}{8}}{\frac{3}{7} + \frac{1}{5}}$ shillings to the fraction of 9s. 2d. $\frac{147}{2110}$. Ans.

4. A bicyclist and a tricyclist go a journey of 210 miles; the former does the distance in 10½ hours, and the latter in 17½ hours; how much longer will it take the tricyclist than the bicyclist in a journey of 124 miles.

210 : 124 :: 7hrs. : 4hrs. 8min. Ans.

B.

1. Add ·8258, 98, and 7·0131: from the sum take 101·0654 and divide the remainder by ·3.

(·8258 + 98 + 7·0131 − 101·0654) ÷ ·3
= 15·9116. Ans.

2. I travel 12½ miles for 1s. 9d.; how much ought I to pay for 21⅞ miles?

12½ : 21⅞ :: 1¾s. : 3s. 0¾d. Ans.

3. How much will £600 amount to in 6 years, at 4 per cent. per annum?

£600 + £144 = £744. Ans.

4. One-fourth of a pole is in the mud, ⅖ in the water, and 5 feet out of the water. What was the length of the pole?

$1 - (\frac{2}{5} + \frac{1}{4}) = \frac{1}{1\frac{3}{3}}$

$1\frac{1}{3}$: 1 :: 5 ft. : 6o ft. Ans.

STANDARD VII.

1. Find the average of 15, $10\frac{2}{5}$, ·075, 0, 4·025.

(15 + 10·4 + ·075 + 0 + 4·025) ÷ 5
= 5·9. Ans.

2. In a town of 75,600 the percentage of deaths is $1\frac{3}{14}$. How many deaths are there?

100 : 75600 :: $1\frac{3}{14}$: 1458. Ans.

3. A grocer buys 3 cwt. of sugar for 3 guineas, and retails the same at 3d. per lb. What does he gain per cent.?

336 × 3d. = 1008d. = £4 4s.

3 : 100 :: 1 : $33\frac{1}{3}$. Ans.

4. If 77·5 per cent. of a school are over 7 years of age and there are 99 under 7, how many are there in the school.

100 − 77·5 = 22·5

22·5 : 100 :: 99 : 440. Ans.

Dictation and Composition.

STANDARD I.

Once, Sheep, Market, Horse, Nothing, Went, Head, Said, Little, Fields.

STANDARD II.

In a minute or two they were all safe, seated on the cross-benches of the new boat. And well in the middle, sitting there, looking cold and blue, shivering and shaking, and the water streaming from their wet clothes.

STANDARD III.

I will venture everything to gain him and an immortal soul. Whilst my sisters are dancing in my father's palace I will go to the water witch of whom I have always been so afraid; but she can perhaps advise and help me. Now the little seamaid left her garden and went to the roaring whirlpool beyond which the water witch dwelled.

STANDARD IV.

No cry of anguish, no wild shriek of men in agony,
No drooping down of watchers weak, weary, and glad to die.

Generally, even though you sit down with a disinclination, that feeling will give way before your resolution, and before the time is ended, you will find that you have conquered, and that the work has been carried on with heartiness.

Grammar and Analysis.

STANDARD III.

(*a*) Pick out verbs and adverbs from dictation.

(*b*) Pick out pronouns and adjectives from dictation.

STANDARD IV.

Parse and Analyse:—

(*a*) In summer time the sun shines brightly.

(*b*) You never saw my brother.

STANDARD V.

Parse and Analyse:—

(*a*) Once a little girl was walking in a shady wood near her home.

(*b*) I never heard that man's name.

STANDARD VI.

Parse and Analyse:—

(*a*) When the huge stone sank o'er the tomb.

(*b*) The night returned in double gloom.

—o—

Matriculation Examination.

June, 1886.

Latin.

I. *Latin Translation.*

A.

Fabius led his army along the heights at a slight distance from the enemy, in order that he might neither miss him nor fall in with him. The soldiers, except so far as necessary wants compelled, were held within the camp; they went to seek forage and wood neither in small numbers nor over a wide area; a picket of the horse and of the light-armed troops was formed and drawn up in readiness for sudden skirmishes, and rendered the whole situation safe for our soldiers, and unfavourable to the spreading of the enemy's foragers. The decision of the whole campaign was not staked on a battle which risked the whole army; and slight encounters where little was at stake, begun from a safe ground, with a place of retreat near, accustomed the soldiers, who had been demoralised by their former defeats, now at last to have more confidence in their valour or fortune. But Fabius did not find Hannibal more his foe in such sound measures than the Master of the Horse, who was only prevented from hurrying the State into imminent peril by the fact that he was subordinate in authority—a man rash and foolhardy in counsel and intemperate in language. At first among a few, then openly to the common soldiers, he called the Dictator instead of steady, dilatory; instead of cautious, timid—attaching to his virtues the names of their kindred faults—and by depreciating his superior—a dishonourable device which has grown by the too great success of many—he raised himself.

B.

Having stipulated with the condition that they should hand over their arms and horses, that the ransom of the persons of Romans should be three hundred sesterces (stamped with a *quadrigu*) apiece; of the allies two hundred, and of the slaves one hundred; and that after paying this sum they should depart with a garment apiece, they received the enemy into their camp. All were handed over into custody, the citizens and allies apart. While time was being spent there, since in the meantime those who had sufficient strength and spirit, to the number of four hundred foot and two hundred horse, some in column, some straggling all over the country—a plan quite as safe—had escaped from the greater camp to Canusium, the camp itself was handed over to the enemy by the wounded and panic-striken remainder, on the same terms as the other. Vast booty was taken, and except the horses and the men, and whatever silver there was, all the booty was given up to plunder. This silver consisted mostly of the frontlet-plates of the horses; for the Romans, at least while in the field, used very little plate silver for eating purposes.

II. *History and Geography.*

1. During the second Punic War there were *four* praetors annually elected, two of whom were at Rome, and two abroad, namely one in Sardinia and one in Sicily. Of the two home praetors, one, the *Praetor Urbanus*, was to act as supreme judge in the civil court, and he took his seat on the curule chair in his *Tribunal*, for this purpose, on every *dies fastus*, *i.e.*, every day on which it was lawful to transact legal business. He also, ex officio, presided at the *Ludi Apollinares* and the *Ludi Piscatorii*. These offices comprised the *Urbana Jurisdictio*.

The other, the *Praetor Peregrinus*, decided cases between citizens and non-citizens.

The Praetors were regarded as inferior colleagues of the consuls. They wore the *toga praetexta*, used the *sella curulis*, and were in Rome attended by two lictors. The Praetor Urbanus was regarded as superior in dignity to the rest, and was styled the *Praetor Major*; but the charge entrusted to each was decided by lot. At this time all the praetors might be plebeians.

The chief judicial function of the praetor was the appointment of a *judex*. He only interfered directly by means of an *interdictum*. This took place usually in personal disputes about possession.

2. A Roman legion of the time of Scipio was marshalled in three lines. The *Hastati*, 1200 in number, were young men, and formed the first line; the *Principes*, also 1200 in number, were men in the prime of life, forming the second line; while the *Triarii*, experienced veterans, 600 in number, formed the third line. Besides these there was a corps of light-armed skirmishers, who were called *Velites* or *Procubitores*, including two parts, the *Accensi* and *Rorarii*. These were 1000 in number. Thus the legion proper was 4000 men; but the fixed limit was rarely adhered to.

Each line was divided into ten *Maniples*, and each maniple into two *Centuries*, so that altogether each legion contained 30 Maniples and 60 Centuries. About the time of Scipio the Maniples began to be combined together in *Cohorts*. Each legion thus contained ten Cohorts; and each Cohort three Maniples or six Centuries.

The defensive armour of the Hastati, Principes, and Triarii was alike; but the Hastati and Principes had the *Pilum*, the Triarii the *hasta*.

These alone constituted the legion proper. But until the time of Marius it was usual to reckon along with it the Cavalry and the Allies.

The Cavalry consisted properly of 300 men, who were distributed into ten *Turmae* or squadrons of 30 men each. Each Turma consisted of three *Decuriae* of ten men each. The commander of the whole cavalry was the *Praefectus Alae*; of the decuria, the *Decurio*. In the time of Scipio the armour of the cavalry was a heavy spear, a cuirass, and a buckler.

The Allies (*Socii*) were divided and armed precisely like the Roman legions. One third of the allied cavalry and one fifth of the infantry attended the consul under the title of *Extraordinarii*. The remainder were distributed on the wings of the legion, and were called *Dextera Ala* and *Sinistra Ala*. Hence the Allies generally were often called *Alarii*.

3. (*a*) Varro is here said to have been through *both* aedileships—*i.e.* the *curule* and the *plebeian*. All that at a later period was necessary was that a candidate for the consulship should have been *curule* aedile.

(1) The plebeian aedileship was founded in 494. It was concerned with buildings, temples, etc.; the management of roads and the water supply; the distribution of corn, all matters of buying and selling, and the oversight of the markets. It alone had the care of the *Ludi Plebeii*.

(2) The curule aedileship was founded in 365. At the time of the Second Punic War there were two curule aediles, who had the privilege of wearing the toga praetexta, and using the curule chair, and had also the 'jus imaginum.' They had the oversight of the *Ludi Magni* and the *Ludi Scenici*.

(*b*) These were the *Decemviri Sacris Faciundis* (or *Sacrorum*) who had charge of the Sibylline Books, and inspected them on special occasions by command of the Senate. They celebrated the *Ludi Apollinis* and *Ludi Saeculares*, and were in fact regarded as priests of Apollo. Two occasions on which they exercised their functions are mentioned in this book, one after the defeat of Flaminius, the other after the discovery of the crime of the Vestals.

(*c*) *Aes grave* often denoted the old heavy copper coinage. At first the *as* was equal to a pound, then it was diminished to one-sixth of a pound, and finally, during the dictatorship of Fabius, to one ounce. The *aes grave* then meant the full *as* of one pound. But it came to mean any quantity of copper coins, of whatever weight or coinage, reckoned not by tale, but by the old standard of a pound weight to the as; and this standard was actually maintained in certain payments, *e.g.*, military pay, fines, or the present instance.—*Aes grave* often meant simply uncoined metal.

(*d*) The *Feriae Latinae* were an old Latin festival, held upon the Alban Mount. The Magistrates could appoint the time of their celebration, or propose their repetition. They originally lasted for one day, but one and more days were added from time to time. No consul could take the field till the *Latinae* had been held; and Flaminius was thought sacrilegious for having omitted them.

(*e*) These are the words of the old Senatorial vow: *Clepsit* is the perf. subj., old form, of a verb clepo, connected with the Greek κλέπτω.

(*f*) A dictator could only be nominated by a consul after due consultation of the auspices and certain other formalities, the nomination ought to take place in secret. It is probable that in this case these formalities had been neglected, and that thus there was a flaw (vitium) in the election of the dictator. Since then he had to resign his office, the comitia for election of consuls could not be held, and an 'interregnum' ensued.

4. *Tarraco*, the modern Tarragona, a town upon the north east coast of Spain, a little north of the mouth of the Iberus.

Allifae, a town in Samnium between Venafrum and Telesia, near the River Vulturnus.

Casilinum, in Campania, a few miles north west of Capua, nearer the mouth of the Vulturnus than Allifae.

Cortona, a little north of the Trasimene Lake, and south of Arretium.

Arpi, in Apulia, south west of Mt. Garganus, a little east of the Apulian Luceria.

Caere, in Etruria, rather west of Veii, upon the Aurelian Way, south of the Sabatine Lake.

Antium, about the middle of the coast of Latium, about thirty miles along the coast from Ostia.

Ebusus, the modern Iviça, one of the Balearic Islands, south west of Majorca.

Paestum, upon the west coast of Lucania, near the river Silarus, a little north west of Velia.

Ostia, the port of Rome, on the coast of Latium upon the left bank of the Tiber.

III. Passages for translation from books not previously given.

A.

There was the greatest dearth of fodder, so that they fed their horses on leaves stripped from trees, and on the tender roots of reeds which they had bruised. But after not only the barley and fodder and herbs had everywhere been cut down, but even the foliage was failing from the trees, when the horses had been wasted to skeletons, Pompey thought he must make some attempt at a sally.

B.

Hannibal held eight thousand men, not those whom he had taken in battle, or who had scattered in flight in peril of their lives, but who had been left in the camp by the consuls. These the Senate did not think fit to redeem, though that could be done at small expense—that it might be ingrained in the minds of our soldiers either to conquer or to die on the field.

C.

Drive far from thee disease: let thy men and thy herds be healthy;
Healthy too thy guard-dogs, a watchful band:
Thus no fewer shall I bring them home than they were in the morning;
Nor shall I groan bringing home fleeces torn by the wolf.
Far be cruel hunger; let leaves be plenty,
And waters to wash the limbs, and waters for their drinking.

Latin Grammar and Composition.

1. *Nubes*—nūbis, nubium, fem.
'Ecce cadunt largi resolutis nubibus imbres.' (*Virg.*)
Obses—obsĭdis, obsidum, masc. and fem.
'Obsidis unius jugulum mucrone resolvit.' (*Ov.*)
Paries—parĭĕtis, parietum, masc.
'Haerent pārĭetĭbus scalae, postesque sub ipsos.' (*Virg.*)
Comes—comĭtis, comitum, masc. and fem.
'Hos cape fatorum comites, his moenia quaere.' (*Virg.*)
Compes—compēdis, compedum (rarely compedium) fem.
'Sed neque compedibus, nec me compesce catenis.' (*Ov.*)
Incus—incūdis, incudum, fem.
'Impositos duris crepitare incudibus enses.' (*Virg.*)
Quercus—quercūs, quercuum, fem.
'Nudaque ramosae tendebant brachia quercus.' (*Virg.*)
Lepus—lepŏris, leporum, masc.
'Fecundi leporis sapiens sectabitur armos.' (*Hor.*)
Tellus—tellūris, fem.
'Exercetque frequens tellurem atque imperat arvis.' (*Virg.*)
Crus—crūris, crurum, neut.
'Et crurum tenus a mento palearia tendent.' (*Virg.*)

2. N.	istaec domus	istaec domus
A.	istanc domum	istasce (domus or) domos
G.	istiusce domus	istarumce domuum or domorum
D.	istic domui	istisce domibus
A.	istac domo	istisce domibus
N.	haec supellex	
A.	hanc supellectilem	
G.	hujus supellectilis	
D.	huic supellectili	
A.	hac supellectile	
N.V.A.	quod mare	quae maria
G.	cujus maris	quorum marium
D.	cui mari	quibus maribus
A.	quo mari	quibus maribus

3. Pres., *Audeo*; Impf., audebam; Fut., audebo; Perf., ausus sum; Plupf., ausus eram; Fut. P., ausus ero; Subj. Pres., audeam; Impf., auderem; Perf., ausus sim; Plupf., ausus essem.

Redeo; Impf., redibam; Fut., redibo; Perf., redii; Plupf., redieram; Fut. Perf., rediero; Subj. Pres., redeam; Impf., redirem; Perf. redierim; Plupf., rediissem.

Aufero; Act., Impf., auferebam; Fut., auferam; Perf., abstuli; Plupf., abstuleram; Fut. Perf., abstulero; Subj. Pres., auferam; Impf., auferrem; Perf., abstulerim; Plupf., abstulissem.

Pass. Pres., auferor; Impf., auferebar; Fut., auferar; Perf., ablatus sum; Plupf., ablatus eram; Fut. Perf., ablatus ero; Subj. Pres., auferar; Impf., auferrer; Perf., ablatus sim; Plupf., ablatus essem.

Malo; Impf., malebam; Fut., malam; Perf., malui; Plupf., malueram; Fut. Perf., maluero; Subj. Pres., malim; Impf., mallem; Perf., maluerim; Plupf., maluissem.

4.	misceo	miscui	misturus	mixturus
	torqueo	torsi	torturus	
	mordeo	momordi	morsurus	
	adoleo	adolui	adulturus	
	pango	pepigi	pacturus	
	struo	struxi	structurus	
	texo	texui	texturus	
	tundo	tutudi	tunsurus	tusurus
	ĕdo	ēdi	esurus	
	ēdo	edidi	editurus	

5. The termination -culum (sometimes -clum) is used in forming nouns from verbs, and expresses the instrument, and sometimes the place, of the action expressed by the verb: *e.g.* gubernaculum, rudder (from guberno), coenaculum, dining-room (coeno), vehiculum (veho), ferculum, bier (fero).

(The termination -culus, -cula, -culum is also a diminutive: homunculus, a wretched little fellow; muliercula, a little woman; specula, a small ray of hope; munusculum, a little gift; vasculum, a little vessel.)

-men denotes the thing performing the action expressed by the verb: flumen, river (fluo); lumen, a light (luceo); often it has a passive force, as in agmen, from ago, that which is driven or led; semen, that which is sown; and perhaps carmen (casmen), that which is sung.

-tudo expresses an abstract quality (it is almost indistinguishable in meaning from -tas). Words in -tudo are usually formed from adjectives: rectitudo (rectus), consuetudo (consuetus), altitudo (altus), aegritudo (aeger).

-ax denotes (1) a propensity, usually a bad one: pugnax, edax, loquax; (2) nothing more than a present participle, as minax = minans, fallax = fallens; (3) power or capability, as capax, able to hold or take.

-osus denotes fulness, or tendency to bring about anything: periculosus, full of peril; damnosus, full of loss; vinosus, full of wine; calamitosus, bringing calamity. Used with nouns.

-ensis is added to noun-stems, and denotes that the thing belongs to the place denoted by the noun: forensis (forum), castrensis (castra), Atheniensis (Athenae). Very common with names of towns in *-o*, Narbonensis (Narbo).

-idus denotes the condition or quality implied in the verb-stem to which it is added: calidus, warm (caleo); frigidus, cold (frigeo); humidus, damp (humeo). Rapidus (rapio) is an exception, being from the stem of a transitive verb.

-tura expresses the function or office of an agent denoted by *-tor*: praefectura (praefectus), praetura (praetor); (compare censura from censor).

6. *Quisquam* is only found in negative or quasi-negative clauses. It denotes 'a single one,' and coalesces with the negative so as to exclude all. Thus 'nec quisquam,' 'and not a single one.' It can only be used in the singular, and the genitive and abl. are supplied from *ullus*. It is always used as as a substantive, *ullus* being the corresponding adjective.

Quispiam may be either an adjective or a substantive. It may be used in the plural. 'It denotes some one or other.' It may be used in other clauses than negative ones. When used in negative clauses it does not coalesce with the negative, but each retains its proper force.

Nostrum is used in a partitive sense, when a number of persons is spoken of: *e.g.* 'magna pars nostrum,' a great many of us: 'uterque nostrum,' each of us. *Nostri* is used objectively, as 'amor nostri,' or when a single person is spoken of—*e.g.* 'nostri melior pars animus est,' the better part of us is the mind.

Semel has reference primarily to the fact that a thing has occurred only once, it is numerical rather than historical.

Quondam has reference to the fact that the thing has happened in the past, but whether once or oftener it leaves unsaid.

Tres is the simple cardinal; *terni* the distributive, implying that each person or thing concerned received *three apiece*. In poetry it is sometimes used as equivalent to *tres*: 'terni vagantur ductores' (*Virg.*) 'Ternum pedum longitudo' *each* was three feet long; 'trium pedum' *it* was three feet long. Terni is used for *tres* with plural nouns expressing a single notion: thus *terna castra*, three camps.

Uterque means each of two: 'Docte sermones utriusque linguae' (*Hor.*), 'O thou learned in the speech of both nations'; and is usually confined to cases when there is but one on each side. *Utrique* should be properly used when there are more than one on each side—'Each party'—but the rule is constantly broken.

7. Nescio quis adest—'Some one (I don't know who) is present.'
Nescio quis adsit—'I don't know who is present.'
Non dicam quod vult—'I shall not speak as he wishes.'
Non dicam quid velit—'I shall not say what he wants.'
Vereor ut hoc facere possis—'I'ma fraid you can't do this.'
Vereor ne hoc faciat—'I'm afraid he will do it.'
Non poteram rem conficere—'I wasn't able to finish the work.'
Non potui rem conficere—'I have not been able to finish the work.'
Hoc facit ne quis exire possit—'He does this that no one may be able to go out.'
Hoc facit ut nemo exire possit—'He does this, with the result that no one can go out.'

8. *Libet*—with dative of person, infin. of thing—'Non libet mihi deplorare vitam' (*Cic.*); often used absolutely: 'adi, si libet.'
Decet—accusative of person, and a noun or an infin. of thing: 'Non te mihi irasci decet.'
Paenitet—accus. of person, genitive of thing: 'Num hujusce te gloriae paenitebat?'
Coram—as adverb used absolutely; as preposn. with abl.: 'Coram genero meo quae dicere ausus es?' (*Cic.*)
Interest = inter rem est: hence it takes the *genitive* of nouns or pronouns: 'Quid illius interest, ubi sis?' (*Cic.*)
The *possessive* pronouns would naturally be meam, tuam, etc.; but they have lost the final *m*: hence we have what is apparently an ablative: 'Tua et mea maxime interest, te valere' (*Cic.*) It is also used with accusative and infin. or with a qualifying adverb, as multum, plurimum, maxime. N.B. also the constructions 'quid interest,' 'nihil interest.'
Vaco—ablative (with or without *ab*) of that which we are free *from*; dative of that which we have leisure *for*: 'Philosophiae semper vaco' (*Cic.*); 'Ejusmodi motibus sermo debet vacare' (*Cic.*)
Laedo—accusative of object: 'Injuste neminem laesit' (*Cic.*)
Eripio—accusative of thing taken away, that from which it is taken away *if a thing*, is in abl., or abl. with ex, ab, or de; if a *person*, usually in the *dative*: 'Eripit classem *Caesari*' (*Caes.*) 'Eripit hirundines *ex nido*' (*Pl.*) 'Eripere ensem *vagina*' (*Virg.*)

9. (*a*) Quis mihi dicere potest quando futurum sit ut liber meus reddatur?
(*b*) Is qui pecunia non bene utitur, dignus est cui adimatur.
(*c*) Si qui miles duci non pareret, gravissimam poenam solveret.
(*d*) Dixit nemini obliviscendum esse eorum qui ipsum miserum adjuvissent.
(*e*) Pollicitus est mihi se nunquam iterum me invito domo abiturum.
(*f*) Avunculus meus quindecim annos Syracusis vixit, sed Neapoli duos et septuaginta annos natus obiit.
(*g*) Duo millia modiûm frumenti denis sestertiis emerunt.
(*h*) Si id quod oportet bene facis, nihil est quare quispiam te incuset.
(*i*) Miser puer, furti reus factus, ab omnibus judicibus absolutus est.
(*k*) Tantos ludos spectatum vicinae tribus frequentes venerunt.
(*l*) Utrum notus esse an privatus semper vivere velles?
(*m*) Mox disces quid sit tuum officium, si magistris auscultas.

Arithmetic and Algebra.

1. Multiplying out in the ordinary way.

$$\begin{array}{r} 3{\cdot}73205 \\ {\cdot}26795 \\ \hline 1866025 \\ 3358845 \\ 2612435 \\ 2239230 \\ 746410 \\ \hline 1{\cdot}0000027975 \end{array}$$

We get as answer, correct to five places of decimals, 1.

Now this may at once be seen to be correct; for to 5 places of decimals $\sqrt{3} = 1{\cdot}73205$ and therefore the sum requires us to multiply together $2 + \sqrt{3}$ and $2 - \sqrt{3}$. The product of these is of course $2^2 - (\sqrt{3})^2 = 4 - 3 = 1$.

2. Let x represent the value of $\cdot\dot{2}\dot{7}\dot{9}$.

$$\therefore 10x = 2{\cdot}7979\ldots(2)$$
$$1000x = 279{\cdot}7979\ldots(3)$$

From (3) subtract (2)

$$990x = 277$$
$$\therefore x = \tfrac{277}{990}.$$

(The same result may be obtained by a simple application of the summation of an infinite Geometrical Progression.)

3. The simplest method is to reduce the denominator to a perfect square.

$$\frac{1}{\sqrt{\cdot 4}} = \sqrt{\frac{1}{\cdot 4}} = \sqrt{\frac{10}{4}} = \tfrac{1}{2}\sqrt{10}$$

$\sqrt{10}$ can be found in the ordinary way to any required number of decimal places.

$$\begin{array}{r|l} & 10\ (3{\cdot}1623 \\ 9 & \\ \hline 61) & 100 \\ & 61 \\ \hline 625) & 3900 \\ & 3750 \\ \hline 6322) & 15000 \\ & 12644 \\ \hline 63243) & 235600 \\ & 189729 \end{array}$$

Hence $\frac{1}{\sqrt{\cdot 4}} = \frac{1}{2} \times 3{\cdot}1623 = 1{\cdot}5811$ — nearly.

4. At the end of *one* year he will receive the sum lent and the interest upon it for one year.

Now the interest on £114 11s. 8d. at 3 per cent. is

£114 11s. 8d. $\times \frac{3}{100}$

or $\frac{\text{£}343\ 15\text{s. }0\text{d.}}{100}$

or £3 8s. 9d.

Now £3 8s. 9d. + £114 11s. 8d. = £118 0s. 5d.

Therefore he will receive £118 0s. 5d. at the end of one year.

He lends this sum on the same terms: therefore he will receive £118 0s. 5d. + its interest for one year at 3 per cent.:

or £118 0s. 5d. + £118 0s. 5d. × $\frac{3}{100}$

$= £118\ 0s.\ 5d. + \frac{£354\ 1s.\ 3d.}{100}$

$= £118\ 0s.\ 5d. + £3\ 10s.\ 9\frac{3}{4}d.$

$= £121\ 11s.\ 2\frac{3}{4}d.$

5. The Common Denominator is obviously

$$(a-b)(b-c)(c-a)$$

Hence the left-hand side of the identity $=$

$$\frac{-(a+x)(a+y)(b-c)-(b+x)(b+y)(c-a)-(c+x)(c+y)(a-b)}{(a-b)(b-c)(c-a)}$$

Multiplying out, we find that the numerator $=$

$$-a^2(b-c)-ax(b-c)-ay(b-c)-xy(b-c)$$
$$-b^2(c-a)-bx(c-a)-by(c-a)-xy(c-a)$$
$$-c^2(a-b)-cx(a-b)-cy(a-b)-xy(a-b)$$

and collecting common terms we see at once that the coefficient of xy vanishes, and also those of x and y.

Therefore the fraction becomes

$$= -\frac{a^2(b-c)+b^2(c-a)+c^2(a-b)}{(a-b)(b-c)(c-a)} \qquad (1)$$

$$= -\frac{a^2b-a^2c+b^2(c-a)+ac^2-bc^2}{(a-b)(b-c)(c-a)}$$

$$= -\frac{ca(c-a)+b^2(c-a)-b(c^2-a^2)}{(a-b)(b-c)(c-a)}$$

$$= -\frac{(c-a)[ca+b^2-b(c+a)]}{(a-b)(b-c)(c-a)}$$

$$= -\frac{(c-a)(b-a)(b-c)}{(a-b)(b-c)(c-a)} = 1$$

(That the numerator of (1) is equal to the denominator may be seen at once by the student who is acquainted with an important algebraic principle. For the numerator vanishes when $a = b$; and therefore $a - b$ is a factor; and similarly $b - c$ and $c - a$ are factors. And since the numerator is of the third degree, it $=$ P $(c-a)(a-b)(b-c)$ where P is a constant; and by giving any values we please to a, b, c, we determine P $= -1$.)

5. (2) Plainly, this is but an example of the preceding, a being $\frac{1}{x}$, $b\ \frac{1}{y}$, $c\ \frac{1}{z}$, $x\ \frac{1}{x}$, $y\ \frac{1}{y}$. And therefore, without working the sum out, we see that the answer must be 1.

6. By the ordinary process—

$$6x^3 - 13x^2 - 21x + 18)\ 6x^3 - x^2 - 20x + 12\ (1$$
$$6x^3 - 13x^2 - 21x + 18$$
$$12x^2 + x - 6$$

$$12x^2 + x - 6)\ 6x^3 - 13x^2 - 21x + 18\ (\ \text{Multiplying the dividend by 2, according to a well-known rule, we get}$$

$$12x^2 + x - 6)\ 12x^3 - 26x^2 - 42x + 36\ (x - 9$$
$$12x^3 + x^2 - 6x$$
$$-27x^2 - 36x + 36$$

This again we may multiply by 4

$$-108x^2 - 144x + 144$$
$$-108x^2 - 9x + 54$$
$$-135x + 90$$

Dividing by -45 we get

$$3x - 2)\ 12x^2 + x - 6\ (4x + 3$$
$$12x^2 - 8x$$
$$9x - 6$$
$$9x - 6$$

Hence $3x - 2$ is the G.C.M.

It is a great saving of time, in working sums involving division, to write *coefficients only*. Thus the present sum may be worked thus:

$$6 - 13 - 21 + 18)\ 6 - 1 - 20 + 12\ (1$$
$$6 - 13 - 21 + 18$$
$$12 + 1 - 6$$

$$12 + 1 - 6)\ 6 - 13 - 21 + 18\ (1 - 9$$
$$2$$
$$12 - 26 - 42 + 36$$
$$12 + 1 - 6$$
$$-27 - 36 + 36$$
$$4$$
$$-108 - 144 + 144$$
$$-108 - 9 + 54$$
$$-45) - 135 + 90$$

$$3 - 2)\ 12 + 1 - 6\ (4 + 3$$
$$12 - 8$$
$$9 - 6$$
$$9 - 6$$

Thus $3 - 2$, that is $3x - 2$, is the G.C.M.

But care must be taken, where in the full expression a term is omitted, to write its coefficient, namely zero, in the abbreviated form.

Thus $3x^4 - 6x^2 + 3$ should be written $3 + 0 - 6 + 0 + 3$.

7. In the present case the easiest way of solving the problem seems to be to substitute the value of x as given by the first equation, in terms of y and z, in the 2nd and 3rd equations.

$$5x - 3y - 19z = 0 \qquad (1)$$
$$3x - 4y - 12z = 2 \qquad (2)$$
$$11x + 7y + 2z = 1 \qquad (3)$$

From (1) $x = \frac{3y + 19z}{5}$

Substitute in (2) and (3)

$$3 \times \frac{3y + 19z}{5} - 4y - 12z = 2$$

or $9y + 57z - 20y - 60z = 10$

or $11y + 3z = -10 \qquad (5)$

and $11 \times \frac{3y + 19z}{5} + 7y + 2z = 1$

or $68y + 219z = 5 \qquad (6)$

Multiply (5) by 73 and subtract (6) from it, and we get

$$735y = -735$$

whence $y = -1$

then from (5) $z = \frac{1}{2}$

and from (1) $x = \frac{1}{2}$.

8. Suppose that A could do it in a days,

" " B " " b "

" " C " " c "

Then in 1 day A does $\frac{1}{a}$th of the work; B $\frac{1}{b}$th; C $\frac{1}{c}$th.

Hence from the first condition given us

$$\frac{5}{a} + \frac{2}{b} + \frac{3}{c} = 1 \qquad (1)$$

From the second,

$$\frac{6}{b} + \frac{6}{c} = 1 \qquad (2)$$

and from the third,

$$\frac{2}{b} + \frac{2}{c} = \frac{3}{a} \qquad (3)$$

From (2) and (3) by multiplying (3) by 3 we get $\frac{9}{a} = 1$;

$\therefore a = 9$: *i.e.* A can do the work in 9 days. Substituting in (1) we get

$$\frac{2}{b} + \frac{3}{c} = \frac{4}{9}$$

and by (3) $\frac{2}{b} + \frac{2}{c} = \frac{3}{9}$ Hence $\frac{1}{c} = \frac{1}{9}$,

and therefore C also can do it in 9 days.

From (2) we get $b = 18$; hence B can do it in 18 days.

9. Suppose the article originally cost x shillings.

Then it is next sold for $\frac{118}{100}x$ shillings.

Now the purchaser sells it for $4\frac{7}{12}$ shillings.

Therefore *he* gains $4\frac{7}{12} - \frac{11}{10}x$ shillings.

But he gains 15 per cent. of what he sold it at: *i.e.* he gains $\frac{15}{100}$ of $4\frac{7}{12}$ shillings.

Therefore $4\frac{7}{12} - \frac{11x}{10} = \frac{15}{100}$ of $4\frac{7}{12}$.

$$\therefore \frac{85}{100} \text{ of } 4\frac{7}{12} = \frac{11x}{10}$$

$$\therefore \frac{11x}{10} = \frac{55}{12} \times \frac{85}{100}$$

$$x = \frac{187}{24} \text{ shillings}$$
$$= 3s.\ 6\frac{1}{4}d.$$

Hence 3s. 6¼d. is its original cost.

10. (1) This may be done by simple multiplication.

$5^{10} = (5^2)^5 = 3125^2 = 9765625$

1024	3125
1024	3125
4096	15625
2048	6250
10240	3125
1048576	9375
	9765625

$4^{10} = (4^5)^2 = 1024^2 = 1048576$

1048576)9765625(9·31
9437184
3284410
3148728
1356820

Ans. 9·31 . . .

(This sum may be more simply solved by an easy application of the Binomial Theorem.)

(2) The first hundred feet take 1 day.
the second " " $\frac{4}{5}$ days.
third " " $(\frac{4}{5})^2$ days.
. . . . . .
tenth " " $(\frac{4}{5})^9$ days

Hence altogether the thousand feet take
$1 + \frac{4}{5} + (\frac{4}{5})^2 + \text{— —} + (\frac{4}{5})^9$ days.

That is, summing this series in the ordinary way,

$$\frac{(\frac{4}{5})^{10} - 1}{\frac{4}{5} - 1}, \text{ or } \frac{9{\cdot}31 - 1}{\frac{4}{5}} = \frac{8{\cdot}31}{\frac{4}{5}}$$

$$= 4 \times 8{\cdot}31 = 33{\cdot}24$$

Answer 33·24 days nearly;
or 33¼ days roughly.

Chemistry.

1. Sodium chloride—formula NaCl.

Cold or dilute sulphuric acid has little or no action on common salt, but strong sulphuric acid, especially if aided by heat, gives sodium hydrogen sulphate, and hydrochloric acid.

Equation—$NaCl + H_2SO_4 = NaHSO_4 + HCl$.

If there is an excess of sodium chloride we get sodium sulphate and hydrochloric acid at a high temperature.

Equation—$2NaCl + H_2SO_4 = Na_2SO_4 + 2HCl$.

Zinc—symbol Zn.

Zinc will dissolve in the acid whether strong, dilute, hot, or cold, giving as a result hydrogen and zinc sulphate.

Equation—$Zn + H_2SO_4 = ZnSO_4 + H_2$.

Copper—symbol Cu.

Sulphuric acid will not attack copper except when heated in the concentrated condition. On heating strong sulphuric acid with copper filings, sulphur dioxide is given off and copper sulphate is formed.

Equation—$2H_2SO_4 + Cu = CuSO_4 + SO_2 + 2H_2O$.

Nitre—formula KNO_3.

On heating nitre with concentrated sulphuric acid, nitric acid, and potassium hydrogen sulphate result.

Equation—$KNO_3 + H_2SO_4 = HNO_3 + KHSO_4$.

Oxalic Acid—formula $C_2H_4O_4$.

If oxalic acid is heated with strong sulphuric acid it is dehydrated and decomposed—giving carbon monoxide and dioxide.

Equation—$C_2H_4O_4 + H_2SO_4 = CO + CO_2 + H_2SO_4.H_2O$.

2. The decomposition may be expressed by the equation:—

$NH_4.NO_3 = N_2O + 2H_2O$

Atomic Weight of N = 14
" " H = 1
" " O = 16

∴ From the above equation we see that 80 grammes of ammonium nitrate give on decomposition 44 grammes of nitrous oxide. We know that 1 litre of hydrogen weighs ·0896 gramme at standard pressure and temp. ∴ 1 litre of nitrous oxide under same conditions, weighs $\frac{44}{2} \times {\cdot}0896$ grammes = 1·9712 gramme. 1 litre at 15° and under 740 m. m. pressure will weigh $1{\cdot}9712 \times \frac{273}{288} \times \frac{740}{760}$ (in agreement with the laws of Boyle and Charles) = 1·8193 grammes.

From equation—it requires 80 grammes of ammonium nitrate to give 44 of nitrous oxide.

∴ $\frac{80}{44}$ gr. of NH_4NO_3 give 1 gr. of N_2O.

∴ $\frac{80}{44} \times 1{\cdot}8193$ gr. of NH_4NO_3 give 1·8193 gr. of N_2O.

= 3·308 gr. of NH_4NO_3 give 1·8193 gr. of N_2O—but this is the weight of 1 litre of N_2O at 15° C and 740 m. m. pressure.

∴ The weight of ammonium nitrate required is 3·308 grammes.

3. There are several methods of obtaining sulphur dioxide, among which are the following—

(*a*) Deoxidise sulphuric acid by means of such substances as carbon and copper.

The acid must be strong and hot, and on adding it to the copper or charcoal the gas is given off and may be collected over mercury or by downward displacement.

(*b*) To obtain pure sulphur dioxide, heat sulphur and sulphuric acid together, $2S + H_2SO_4 = 3SO_2 + 2H_2O$, or decompose a sulphite by an acid thus—$Na_2SO_3 + H_2SO_4 = Na_2SO_4 + SO_2 + H_2O$.

(*c*) Roast a metallic sulphide—for example iron pyrites (FeS_2)—in air.

$2FeS_2 + 11O = Fe_2O_3 + 4SO_2$.

Sulphur dioxide is a gas easily liquefiable, colourless, and incombustible—solidifies when exposed to great cold. It is very soluble in water, giving an acid solution which, when exposed to air, gradually becomes oxidised to sulphuric acid. Acts as a strong reducing agent.

In medicine it is used as a disinfectant.

3. (*continued*)—How could you demonstrate the volumetric composition of the gas?

This may be done by preparing the gas by burning sulphur in oxygen.

Take an eudiometer—introduce a certain quantity of oxygen, then having introduced a fragment of sulphur into the eudiometer on a spoon which is connected with an electric battery—pass a current which shall ignite the sulphur. After letting the eudiometer cool it will be found that the volume of sulphur dioxide is exactly equal to that of the oxygen before the combustion.

∴ 1 molecule of sulphur dioxide contains one molecule of oxygen—or 32 parts by weight. But the molecule of the dioxide weighs 64 parts by weight. ∴ it contains 32 of sulphur or 1 atom. ∴ its molecular formula is SO_2.

4. Marsh gas $= CH_4$.

In combustion $CH_4 + 2O_2 = CO_2 + 2H_2O$.

∴ 1 vol. of CH_4 requires 2 of oxygen for complete combustion. But of 5 vols. of air only 1 vol. is oxygen; ∴ to burn 1 volume of marsh gas we shall require 10 of air.

Olefiant gas $= C_2H_4$.

In combustion reaction is represented by

$$C_2H_4 + 3O_2 = 2CO_2 + 2H_2O$$

i.e. 1 vol. of olefiant gas requires 3 of oxygen, but in 5 of air there is 1 vol. of oxygen ∴ the olefiant gas will require 15 vols. of air to completely burn it.

The products are the same in each case, viz., carbonic acid and steam or water. The formulæ show the volumetric composition.

Carbon dioxide—CO_2—contains its own volume of oxygen.

In water—H_2O—the hydrogen and oxygen are in the proportion 2 : 1 (by volume).

5. By what tests could you distinguish between carbonate of lime and fluor-spar?

This is merely to show the tests for a carbonate and those for a fluoride.

1. To the *carbonate* add hydrochloric acid—effervescence and a gas given off which will turn lime-water to a milky colour.
2. Heat the *carbonate* to redness—there is given off a gas without smell and which gives to lime-water a milky colour.

Trying the same on the fluor-spar no such actions take place—and the following reaction is peculiar to it.

Powder the fluor-spar—put it into a leaden vessel and add a little strong sulphuric acid. Heat the vessel and contents—strong fumes are given off which possess the power of etching glass.

6. Silica or silicon dioxide occurs in nature, in the form of fine crystals of quartz or rock crystal. This is the chief form and is usually found in hexagonal crystals. Another crystalline variety much less common is tridymite crystallizing in the hexagonal system, usually occurring in twin-crystals.

Amorphous varieties of silica are opal, which is coloured or colourless, agate, cairngorm, jasper, &c.

To distinguish rock-crystal from diamond such characteristics as solubility may be made use of.

Silica is soluble in hot solutions of the alkalies and is soluble slightly in solutions of the alkaline carbonates.

The diamond is insoluble in these solutions. At a very high temperature silicon fuses to a clear transparent glass and only under special conditions can it be vaporised. The diamond is combustible at exceedingly high temperatures, forming carbonic acid gas.

Optically—the diamond crystallises according to the regular system—*e.g.* octohedron—whilst the quartz crystallises according to the hexagonal system and is usually transparent. The diamond refracts light very strongly.

Greek.

I. TRANSLATION.

A.

Her. O hail, thou roof and portico of my hearth!
How joyful do I see thee, coming into light!
Ah, what is it? My children before the doors
I see, with heads wreathed with the adornments of the dead,
And in a crowd of men my consort
And my father, weeping—for what calamities?
Come, let me ask of these, standing near them,
What strange chance has befallen my house?

Amph. O best-beloved of men, O thou that hast come a light to thy father,
Art thou here, art thou safe, and arrived, at the extremity of thy loved ones?

Her. What sayst thou? what is this tumult, father, into which we have come?

Meg. We are on the brink of ruin. But do thou, sire, pardon me,
If I beforehand have snatched what it behoved thee to say to this man.
For woman-kind, I ween, is more prone to grief than men;
And my children were at the point to die, and I was about to perish.

B.

Iris. Fear nothing, ancients, though ye see here this child of Night, Madness;
And me, the handmaid of the gods, Iris;
For we have come, no bane to the city,
But we march against the house of one man only,
Who, they say, is sprung from Zeus and Alcmene;
For before he had brought to an end his bitter labours
Destiny preserved him, nor did Father Zeus suffer
Either me or Hera ever to injure him.
But when he had passed through the labours of Eurystheus,
Hera wills to attach to him the guilt of kindred blood,
By his killing his children, and I will with her.
But come, take with thee a relentless heart,
Thou unwedded daughter of black night,
And madness, and child-murdering passions of the mind,
And leapings of the feet, drive and hurl on this man,
And loosen the moorings of murder;
That having driven through the Acherusian strait
The circlet of comely children by murder of his hands,
He may know what the wrath of Hera with him is,
And learn mine; else the gods have ceased to be,
And mortal power will be great, if he pays not the penalty.

C.

Ah me!
I breathe and see what I should see;
Sky and earth and these, the darts of Helios;
But I lie prone and in a wave and dire tumult of the mind,
And breathe hot breaths, unsteadily and upwards from my lungs.
Behold, why do I, with my young breast and arm moored with chains like a ship,
Sit against a broken pillar of stone,
With corpses hard by where I sit?
My winged darts and bow are spread upon the ground,
Which formerly, allied with my arms,
Were wont to save my breast and be saved by me;
Have I not come back home from Hades again,
After running Eurystheus' course to Hades?
But I see not the Sisyphean rock,
Nor Pluto, nor the sceptre of Demeter's child.
Truly I am distraught. I know not where I am.
Ah who is there of my friends, near or far,
Who will heal this ignorance of mine?
For clearly I see nothing of my wonted life.

II. GRAMMAR.

1. **ἐκλήθης.** 2nd person, singular (aorist 1), indicative, passive, of καλέω, καλέσω, ἐκάλεσα, κέκληκα.

ἐσφαλμένοι. Nominative, plural, masculine, perfect participle, passive, of σφάλλω, σφαλῶ, ἐσφηλα (aorist 1), ἔσφαλον (aorist 2).

θανεῖν. Aorist 2, infinitive, of θνήσκω, θανοῦμαι, ἔθανον, τέθνηκα.

ἐμβεβώς. Nominative, singular, masculine, perfect participle of ἐμβαίνω, ἐμβήσομαι, ἐνέβην, ἐμβέβηκα.

δέδοικας. 2nd person, singular, perfect, indicative, active of δείδω, δείσομαι, ἔδεισα, δέδοικα (strong form δέδια).

δεδορκαν' for **δεδόρκατε.** 2nd person, plural, perfect, indicative (in active form) of δέρκομαι, ἔδρακον, δέδορκα.

ἐξεστεμμένα. Nominative or accusative, plural, neuter, perfect participle, passive, of ἐκστέφω, ἐκστέψω, ἐξέστεψα.

γεγῶτες. Nominative, masculine, plural, perfect participle, active (epic), of γίγνομαι, γενήσομαι, ἐγενόμην, γεγένημαι and γέγονα.

πείσει. 2nd person, singular, future, indicative of πάσχω, πείσομαι, ἔπαθον, πέπονθα; 3rd person, singular, future, indicative, active of πείθω, πείσω, ἔπιθον (aorist 2) and ἔπεισα (aorist 1) πέποιθα.

2. N.	γυνή	γόνν	κύων	ὄρνις	
V.	γύναι		κύον	ὄρνις	
A.	γυναῖκα		κύνα	ὄρνιθα	ὄρνιν
G.	γυναικός	γόνατος	κυνός	ὄρνιθος	
D.	γυναικί	γόνατι	κυνί	ὄρνιθι	

Plural—

N. V.	γυναῖκες	γόνατα	κύνες	ὄρνιθες	ὄρνεις
A.	γυναῖκας		κύνας	ὄρνιθας	ὄρνεις
G.	γυναικῶν	γονάτων	κυνῶν	ὀρνίθων	ὀρνέων
D.	γυναιξί	γόνασι	κυσί	ὄρνισι	

N.	ὕδωρ	ὕδατα
V.	—	—
A.	—	—
G.	ὕδατος	ὑδάτων
D.	ὕδατι	ὕδασι

	μήτηρ	μητέρες
	μῆτερ	—
	μητέρα	μητέρας
	μητρός	μητέρων
	μητρί	μητράσι

3.	σοφός	σοφώτερος	σοφώτατος
	ἰσχυρός	ἰσχυρότερος	ἰσχυρότατος
	σαφής	σαφέστερος	σαφέστατος
	σώφρων	σωφρονέστερος	σωφρονέστατος
	ἡδύς	ἡδίων	ἥδιστος
		(ἡδύτερος)	(ἡδύτατος)
	ταχύς	θάσσων	τάχιστος
		(ταχίων)	
	ῥᾴδιος	ῥᾴων	ῥᾷστος
	μέγας	μείζων	μέγιστος

4.

	Present.	*Imperfect.*	*Future.*	*Perfect.*	*Pluperfect.*	*Aorist.*
	—	—	—	—	—	—
	ἐστί	ἦσαν	ἔσονται	ἐστάσι	ἦσαν	ἦσαν
	εἰσί	ἦσαν	ἔσονται	ἐστάσι	ἦσαν	ἦσαν
	εἰσί	ἦσαν	ἔσονται	ἐστάσι	ἦσαν	ἦσαν
	φέρω	ἔφερον	οἴσουσι	ἐνηνόχασι	ἐνηνόχεσαν	ἤνεγκον
	πάσχω	ἔπασχον	πείσονται	πεπόνθασι	ἐπεπόνθεσαν	ἔπαθον
	βάλλω	ἔβαλλον	βαλοῦσι	βεβλήκασι	ἐβεβλήκεσαν	ἔβαλον
	λαμβάνω	ἐλάμβανον	λήψονται	εἰλήφασι	εἰλήφεσαν	ἔλαβον
	πίπτω	ἔπιπτον	πεσοῦνται	πεπτώκασι	ἐπεπτώκεσαν	ἔπεσον
	ὁράω	ἑώρων	ὄψονται	ἑωράκασι	ἐωράκεσαν	εἶδον

5. The prepositions that govern three cases are (ἀμφί), ἐπί (μετά), παρά, περί, πρός, ὑπό.

ἀμφί = *around* or *about*. ἀμφὶ τὸν χειμῶνα, about winter.

It is not used with the dative in Attic.

ἐπί. General notion, superposition. With genitive, *partial* superposition; with dative, rest in superposition; with accusative, motion towards superposition.

ἐφ' ἵππων ὀχεῖσθαι to ride on horseback.

ἐπὶ τῇ θαλάσσῃ οἰκεῖν to live upon the coast.

ἀναβαινειν ἐφ' ἵππον to mount on horseback.

μετά. General notion, separable connection.

With genitive = *accompanied by*; with dative, *among* (only in poetry); with accusative, *after*, either of space or time.

μετὰ ταῦτα after this; μετὰ τούτων along with these men.

παρά. General notion, alongside of. With genitive, *from the side of*; with dative, *near*; with accusative, motion with a view to nearness.

ἐλθεῖν παρά τινος, to come from someone's neighbourhood.

παρὰ τῷ βασιλεῖ, with the king.

ἰέναι παρὰ νῆας, to go to the ships.

περί. General notion, *around*. With genitive = *de*, about. With dative, *around*, of rest in place, and *concerning*. With accusative, *about*, around. There is no great distinction in meaning.

περὶ τοῦτον τὸν χρόνον, about this time.

πρός. *In the direction of*. With genitive, *on the side of*; with dative, *at, to, in addition to*; with accusative, *towards*.

πρὸς τούτων, in consequence of this.

πρὸς τούτοις, besides this.

πρὸς ταῦτα, with reference to this.

ὑπό. *Under*. Genitive, *from under*; dative, *at under*; accusative, *to under*. With genitive, expresses the agent after a passive verb.

καλῇ ὑπὸ πλατανίστῳ, under a fair plane tree.

ἑάλω ὑπὸ τῶν Ἑλλήνων, it was taken by the Greeks.

III. Unprepared Translation.

1. Now, just as some other takes pleasure in a good horse or dog, or bird, I myself too, only in a yet greater degree, take pleasure in good friends, and if I have any of those advantages from which I think they will receive help on the way to virtue, I teach it and communicate it to others.

2. O dearest of women, unto thee I look,
And my fate rests with you, that I should either be prosperous
Or be nothing, and be deprived of my country
And of my dear brother and of my most dear kinswoman.
We are women, a race friendly to one another,
And most unfailing in keeping secure our common dealings.

3. For it is difficult, when the teacher explains a thing badly, to learn how to do it well; and when the master sets an example of carelessness, it is difficult to be a diligent servant.

French.

I. Translation.

A.

Franklin could not endure aimless talk; he held with certain philosophers that if speech is silver silence is gold. . . . When Franklin was sent as ambassador to France, he came to Paris and went down to Chaillot, where the famous and unfortunate Bailly then lived. Bailly thought he ought, without delay, to pay a visit to the illustrious guest who was honouring the Commune with his presence. He had himself announced. Franklin, who knew him by report, received him very heartily, and exchanged with his visitor the few words which the circumstances demanded. Bailly seated himself by the American philosopher and was silent *ad libitum*. Half-an-hour passes and Franklin has not yet opened his mouth. Bailly takes his snuffbox and offers it to his neighbour, without uttering a word; the latter signs with his hand that he does not take snuff. The dumb interview lasts thus for a whole hour. At length Bailly rises, and Franklin, delighted with having found a Frenchman who could hold his tongue, holds out his hand to him and shakes his affectionately, crying, 'Very well, M. Bailly, very well!'

Franklin never lost a minute. He used to say, 'Hunger looks at the door of the industrious man, but it dare not enter.' . . . He had such a hatred for a lie that he exercised sincerity even in diplomatic functions. When he came to France to treat with Louis XVI., the English Government had him secretly solicited, by friends who assured him of the possibility of a reconciliation between the colonies which he represented and England. He answered simply, 'I am engaged to France; I remain with France;' and he signed the French treaty.

B.

One day, when he was dressed in his Guard's uniform, Henry VIII. lost himself while hunting in Windsor Forest. As the hour of dinner drew near he entered a monastery near Reading, where the abbot invited him, as a great honour, to eat at his table. With an appetite corresponding to the dress he wore, he devoured an ox-tongue. 'You do not acquit yourself badly,' said the abbot; and, offering him a glass of wine, he added, 'You must drink the health of the king, our master. I would give willingly a hundred pounds sterling to be able to eat an ox-tongue with such a good appetite as you. Alas! my poor stomach can hardly digest a wing of fowl.' The king was very cheerful during the meal, and when it was finished he thanked his host for his hospitality, and departed without making himself known. A few weeks after, the abbot was painfully surprised at being arrested by order of the king, and kept in prison. But what troubled him most was to see himself put on a regimen of bread and water. Some days after, as he was bewailing the scantiness of his fare, and was racking his spirit to know how he could have offended the king, they brought him an ox-tongue, which he ate with the voracity of a man who had made a long fast. The king, all at once, came out of a cabinet, where he had been witness of the abbot's

meal. 'Sir,' said he to the astonished abbot, 'pay me a hundred pounds sterling, or you shall remain here for the rest of your life. I have been your doctor, and I have won my fees.' The abbot, well pleased to get off for so little, paid the sum and returned to Reading, where he long remembered the fare and the fees of his royal doctor.

C.

Conqueror of the Lombards, Charlemagne had set up his head-quarters at the town of Aquileia. One Sunday, after mass, he said to his courtiers, 'Let us not allow ourselves to become dulled in idleness; let us, without returning to our dwelling, set off for the chase.' This said, he mounted his horse and galloped towards the plain. Everyone was eager to follow him. The sky was covered with a thick fog; a fine and cold rain was falling. Charlemagne had, in the morning, thrown over his shoulders a sheepskin, which had already been submitted to many other tests. As for the people of his court, they were adorned with rich vestments, which Venetian merchants had brought to them, and sold at great cost in the town of Pavia. . . All day they ran across the plains and the woods, and all day the rain fell, penetrating these rich robes; they were, besides, sadly injured by the branches of the trees, and stained with the blood of the fallow-deer, so much so that the hunters, coming back to the town at the return of night, were no longer covered, except with the shabby rags of their gay costumes. Delighted to have thus punished their frivolous ostentation, Charlemagne wished still further to divert himself at their expense. He ordered that on the morrow each should appear at the palace with his dress of the day before. None of them would have dared to be absent from this *rendezvous*. They presented themselves in confusion at their sad array. Charlemagne, seeing them all united around him, said, laughing, to his chamberlain, 'Go and rub down our hunting dress, and hasten to bring it to us.' This was a labour very soon done, and Charlemagne, while showing his sheepskin intact and always fit for the service, could laugh at his ease at the luxury in tatters of his counts and marquises.

II. Grammatical Questions.

1. (*a*). *argent*, masc. from Latin argentum, *neuter*.
lusce, masc. from Latin luscus, *masc.*
or, masc. from Latin aurum, *neut.*
présence, fem. from Latin praesentia, *fem.*
silence, masc. from Latin silentium, *neut.*

(*b*). 100 men, cent hommes.
300 oxen, trois cents bœufs.
750 sheep, sept cent cinquante moutons.
the year 1886, l'an mil huit cent quatre-vingt-six; *or*, l'an dix-huit cent quatre-vingt-six.

(*c*).

	Fut.	*Pres. Subj.*
	J'irai, nous irons	j'aille, nous allions.
	J'enverrai, nous enverrons	j'envoie, nous envoyions.
	Je peux (puis), nous pouvons	je puisse, nous puissions.
	Je viens, nous venons	je vienne, nous venions.
Plupf. Indic.	il s'était égaré	ils s'étaient égarés.

2. (*a*).

ambassadeur	ambassadrice.
roi	reine.
maître	maîtresse.
abbé	abbesse.
hôte	hôtesse.
serviteur	servante.

(*b*).

heureux	heureux.
royal	royaux
entier	entiers.
épais	épais.
frivole	frivoles.

(*c*). Bois, buvons, buvez.
Dis, disons, dites.
Fais, faisons, faites.
Sache, sachons, sachez.
Hâte-toi, hâtons-nous, hâtez-vous.

3. (*a*).

le cheval	les chevaux.
le repas	les repas.
monsieur	messieurs.
l'eau	les eaux.
le rendez-vous	les rendez-vous.

(*b*). *adj.* good — bon, meilleur, le meilleur, très bon.
adv. — mieux, très bien.

(*c*).

Demandé-je?	cours-je?	ouvré-je?
Demandes-tu?	cours-tu?	ouvres-tu?
Demande-t-il?	court-il?	ouvre-t-il?
Demandons-nous?	courons-nous?	ouvrons-nous?
Demandez-vous?	courez-vous?	ouvrez-vous?
Demandent-ils?	courent-ils?	ouvrent-ils?

Puis-je?	vois-je?
Peux-tu?	vois-tu?
Peut-il?	voit-il?
Pouvons-nous?	voyons-nous?
Pouvez-vous?	voyez-vous?
Peuvent-ils?	voient-ils?

4. (*a*). *Ciel*, *Ciels*, bed-tester, sky in paintings, or climates.
Cieux, heaven, sky.
Chasseur, *Chasseuse* ordinary fem.
Chassereste, 'huntress,' in poetical usage; as *e.g.* of Diana.
This woman is a good witness—cette femme est un bon témoin.
(*Témoin* is masc. because, being derived from the Latin *testimonium*, it denotes really the evidence given, not the person who gives it.)

(*b*).

épais	épaisse.
riche	riche.
vénitien	vénitienne.
honteux	honteuse.
meilleur	meilleure.

(*c*).

Pres.	J'annonce	nous annonçons.
Pret.	J'annonçai	nous annonçâmes.
Pres.	J'échange	nous échangeons.
Pret.	J'échangeai	nous échangeâmes.
Pres.	J'achète	nous achetons.
Pret.	J'achetai	nous achetâmes.
Pres.	Je jette	nous jetons.
Pret.	Je jetai	nous jetâmes.
Pres.	Je me lève	nous nous levons.
Pret.	Je me levai	nous nous levâmes.

5. (*a*)

Un livre	a book
une livre	a pound
chère, subst.	cheer, entertainment, fare
chère, adj.	fem. of *cher*, dear
jeune, adj.	young
jeûne, noun	a fast
médecin	a doctor, physician
médecine	physic, medicine
du pain	some bread
des pains	loaves

(*b*) je ne suis pas tombé
tu n'es pas tombé
il n'est pas tombé
nous ne sommes pas tombés
vous n'êtes pas tombé(s)
ils ne sont pas tombés

je n'ai pas couru
tu n'as pas couru
il n'a pas couru
nous n'avons pas couru
vous n'avez pas couru
ils n'ont pas couru

je ne suis pas parti
tu n'es pas parti
il n'est pas parti
nous ne sommes pas partis
vous n'êtes pas parti(s)
ils ne sont pas partis

je ne suis pas allé
tu n'es pas allé
il n'est pas allé
nous ne sommes pas allés
vous n'êtes pas allé(s)
ils ne sont pas allés

je ne me suis pas diverti
tu ne t'es pas diverti
il ne s'est pas diverti
nous ne nous sommes pas divertis
vous ne vous êtes pas diverti(s)
ils ne se sont pas divertis

(*c*) Ceux-ci font signe de la main qu'ils ne prennent pas de tabac.

6. (*a*). The *adj. little, petit, moindre*, or, *plus petit, le moindre*, or *le plus petit.*
Very little, très petit.
Adv. peu, moins.

(*b*). The *disjunctive* personal pronouns only (*e. g.* lui, moi, toi, eux) are used with prepositions, as
Venez avec *moi*, come with me.
Vous disiez *d'elle*, you were speaking of her.
Nous sommes contre *lui*, we are against him.

(*c*).

	Pres. Part.	*Past Part.*
Courir	courant	couru.
offrir	offrant	offert.
voir	voyant	vu.
croire	croyant	cru.
mettre	mettant	mis.
se taire	se taisant	tu.

7. (*a*) Un, premier (unième in compounds)
deux, deuxième (when there is a third)
second (when there is no third)
quatre, quatrième
cinq, cinquième
neuf, neuvième.

Mon frère est le premier, et moi, je suis le vingt et unième.

(*b*)

je ne vais pas	je n'envoie pas
tu ne vas pas	tu n'envoies pas
il ne va pas	il n'envoie pas
nous n'allons pas	nous n'envoyons pas
vous n'allez pas	vous n'envoyez pas
ils ne vont pas	ils n'envoient pas

je ne paye pas
tu ne payes pas
il ne paye pas
nous ne payons pas
vous ne payez pas
ils ne payent pas — rarely je *paie*, etc.

je ne dis pas	je ne fais pas
tu ne dis pas	tu ne fais pas
il ne dit pas	il ne fait pas
nous ne disons pas	nous ne faisons pas
vous ne dites pas	vous ne faites pas
ils ne disent pas	ils ne font pas.

(*c*) Either—N'ai-je pas été votre médecin et n'ai-je pas gagné mes honoraires?
Or—N'est-ce pas que j'ai été votre médecin et que j'ai gagné mes honoraires?

8. (*a*) Les abbés, charmés d'en être quittes pour si peu, payaient la somme et s'en retournaient à Reading.

(*b*) It is *demi-heure* and not *demie-heure* because *demi* is properly not an adjective but a noun, derived from the Latin *dimidium*. *La demie* is used as a feminine noun to signify the half-hour. Cf. the use of *nu*.

What o'clock is it?	Quelle heure est-il?
Half past one.	Il est une heure et demie.
Half past two.	Il est deux heures et demie.

(*c*)

Riche	richement
heureux	heureusement
brillant	brillamment
entier	entièrement
confus	confusément.

9. (*a*). Notre chasseur n'était pas plus couvert que des honteux débris de son brillant costume.

(*b*). The French possessive adjective is common to all three genders, not only, as in most languages, in the first two persons, but also in the third person. The same form is used for *his*, *her*, and *its*, and it agrees with the noun it precedes in number, gender, and case.

Thus, *his* house	*sa* maison.
her book	*son* livre.
its presence	*sa* présence.

Mon, *ton*, and *son* are used instead of *ma*, *ta*, *sa* before feminine nouns beginning with a vowel or *h* mute.

Son aimable *cousine* Marie.
Mon épée *ton* affection.

But the old form has survived in the expression *m'amour* (my love); and the phrases *ma mie*, *la mie*, *sa mie*, are corruptions of *m'amie*, &c.

(*c*).

Impf.	*Pres. Subj.*
je riais	je rie.
tu riais	tu ries.
il riait	il rie.
nous riions	nous riions.
vous riiez	vous riiez.
ils riaient	ils rient.

je me suis assis
tu t'es assis
il s'est assis
nous nous sommes assis
vous vous êtes assis
ils se sont assis

10. (*a*). Either 'Ne se presenta-t-il pas, confus de son triste équipage?'
or, N'est-ce pas qu'il se présenta, confus de son triste équipage?

(*b*). *Adj. bad*, &c.
mauvais, pire (plus mauvais) le pire, très mauvais.
Adv. badly, &c.
mal, pis, très mal.

(*c*). *Souffrir*, souffrance.
souffrant, souffert, je souffre, je souffris.
tendre, tendresse, tendreté.
tendant, tendu, je tends, je tendis.

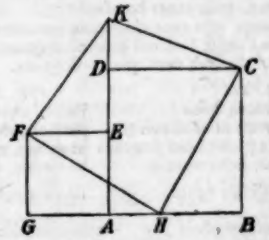
croire croyance croyant.
croyant cru je crois je crus.
connaître connaissance connaisseur.
connaissant connu je connais, je connus.
répondre répondant (a surety) répons réponse.
répondant répondu je réponds je répondis.

Geometry.

1. This is proved Euclid I. 32.

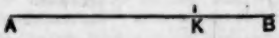
2. This is proved in Euclid I. 47.

Or it may be proved as follows (see Todhunter's Euclid, p. 266).
Let ABCD, AEFG be two squares, placed so that their bases form a straight line.



Make EK, GH equal to AB. Join HC, CK, KF, FH.
Then since GH = AB, take away the common part AH, and HB = GA. Therefore HB = FE.
And CB = EK, since both are equal to AB.
Therefore the triangle EKF is equal to CBH in all respects.
Similarly KDC is equal to FGH.
Therefore the two squares EG, DB are together equivalent to the figure KFHC.
Now, since the triangles CBH, FGH, EKF, and KDC are all equal to one another, the figure KFHC is equilateral.
It is also rectangular. For the angle DKC = CHB, and EKF = HCB. Therefore FKC = CHB + HCB. But CHB + HCB = a right angle (I. 32). Therefore FKC is a right angle.
Similarly KFH, FHC, and HCK are right angles. Therefore KFHC is a square. And FH, its side, is the hypotenuse of a right-angled triangle of which AG and AB are the sides.
Q.E.D.

3. This is solved in Euclid II. 11.



AB is cut into two parts at K so that AB, BK is equal to AK².

Suppose AB represented by a, and BK by x, the problem shows how to find x, so that $ax = (a-x)^2$. Or in other words the problem gives a geometrical solution of the quadratic equation

$$x^2 - 3ax + a^2 = 0$$

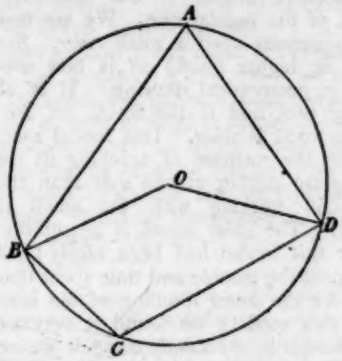
Now the algebraic solution is $x = \frac{3a \pm a\sqrt{5}}{2}$

So that we can by this problem construct a line which is $\sqrt{5}$ times the length of a given line.

4. This is solved Euclid II. 14.

5. This is proved Euclid III. 22.

A very instructive method of proving it is as follows :—



Let ABCD be a quadrilateral inscribed in a circle whose centre is O.

Join BO, DO.

Now the angle BOD is double of the angle BCD (III. 20).

And the *reflex angle* BOD is double of the angle BAD (III. 20).

Therefore the two angles BOD at the centre are together double of the sum of the two opposite angles BAD, BCD.

But the two angles BOD at the centre together are equal to four right angles. (I. 15 Cor. 2)

Therefore BAD and BCD are together equal to two right angles.

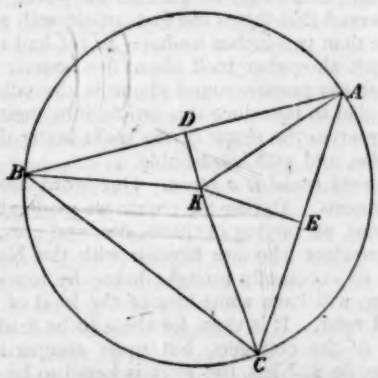
Similarly CBA and CDA are together equal to two right angles.

Q.E.D.

6. If the lines cut *within* the circle, the proposition is proved in Euclid III. 35; if *without*, in the carollary of Euclid III. 36.

7. This is only another way of stating Euclid IV. 5 : to find the centre of a circle which will pass through three points.

Let A, B, C be the points, which must not be in a straight line.



Join AB, BC, CA.

Bisect AB, AC at D, E (I. 10.)

Draw DK, EK at right angles to AB, AC respectively. (I. 11.)

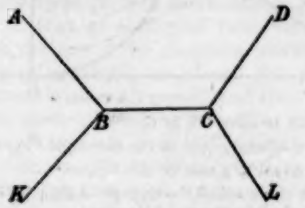
These lines will meet, for if they do not meet they are parallel, and therefore AB, AC will be parallel or in a straight line. Let them meet at K.

Join KA, KB, KC. Then, since AD = DB, and KD is common, and KDB, KDA are both right angles, the side KA = KB. (I. 4.); and similarly KA = KC. Therefore KA, KB, KC are equal. Therefore K is the point required.

If, however, BAC is a straight line, KD, KE *will* be parallel, and the point K cannot be found; or rather it will be at an infinite distance.

8. This is solved in Euclid IV. 15.

In order to form a tesselated pavement we have only to make the side of each hexagon coincide with the side of another.

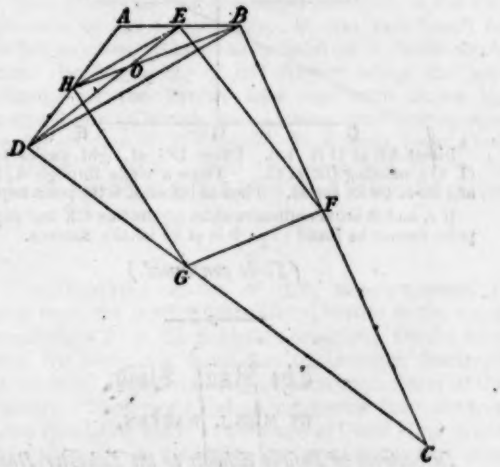


Let ABCD be three sides of a regular hexagon : and KBCL three sides of another equal one, the side BC in both coinciding.

Now by I. 32 Cor. the angle ABC = two-thirds of two right angles. And also KBC = two-thirds of two right angles. Therefore ABK = two-thirds of two right angles. And therefore if a third equal hexagon coincide with the first hexagon in the side AB it will coincide with the second in the side KB.

And similarly we may proceed with any number of hexagons.

9. Let ABCD be a quadrilateral, E, F, G, H the middle points of its sides. Then EFGH shall be a parallelogram.



Join DB, DE, HB; and let HB, DE meet at O.

Then since AH and HD are equal, the triangle AHE = triangle DHE (I. 38).

Similarly AHE = BHE.

Therefore DHE = BHE.

From each take away the part HOE.

Then HOD = BOE.

To each add DOB.

Then HDB = EDB.

But these are triangles upon the same base BD.

Therefore HE is parallel to BD (I. 39).

Similarly it may be shown that GF is parallel to BD.

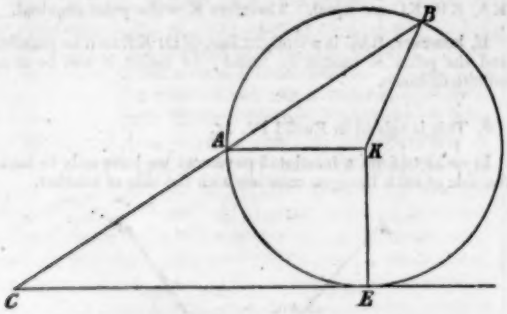
Therefore GF is parallel to HE (I. 30).

Similarly FE is parallel to HG.

Therefore EHGF is a parallelogram. Q. E. D.

10. Let A, B be the given points, CE the given line.

Case I.—When AB is *not* parallel to CE.



Produce BA to meet CE at C.

Construct a square equal to the rectangle CA, CB (II. 14).

Take CE equal to a side of this square.

Describe a circle round the triangle ABE: let K be its centre (IV. 5). K shall be the point required.

For $CE^2 = CA, CB$.

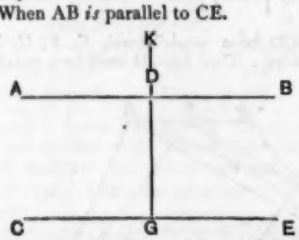
Therefore CE touches the circle at E (III. 37).

Hence KE is perpendicular to CE (III. 16 Cor.), and ∴ KE is the distance from K to the line CE.

And since it is a radius of the circle, KE is equal to KA and KB.

By taking E on the other side of C we shall get the other position of the point.

Case II.—When AB *is* parallel to CE.



Bisect AB at D (I. 10). Draw DG at right angles to AB (I. 11), meeting CE at G. Draw a circle through A, B, G, and let K be its centre. Then as before K is the point required.

If A and B are on opposite sides of the line CE the required point cannot be found: *i.e.*, it is at an infinite distance.

(To be continued.)

—o—

The Näas Slöjd.

BY MISS J. WARREN,

Inspectress of Infant Schools to the Leicester Board.

I THINK long before this paper reaches the eyes of those who have followed me so far, it will be pretty well understood that a six weeks' course at Näas only enabled us to accomplish a carefully-selected number of the models in the series. I find on referring to the book of description given to all students upon leaving, that there are 100 models, 50 from which have been chosen to form, as it were, a course within the course proper. Out of this 50 most of us only succeeded in completing 40, ending with an ordinary stool in firwood. These forty articles are not selected consecutively, but in them are embodied all the manipulations to be found in the 100 models proper. Thus, the number 50 occurs upon the 96th model in the list, is made of firwood, and is a nice little portable book-shelf, while the 100th model consists of a sort of cask, also in firwood. Very few tools occur in the 100th model, and no new ones. When students are able to go to Näas for the second course, which, in Herr Abrahamson's opinion, fits them for any teaching necessary in elementary Slöjd work, they usually complete the whole set of articles, and are then quite capable of making any additions necessary to continue their own studies in private.

The butter spade, with which I ended my last paper, is the seventh article in our selected list, and the ninth of the regular one. We are now to exercise our ingenuity upon a small *ruler*. Such an one (only of far higher finish) as is now used by our scholars in geometrical drawing. It is about nine inches by two, and is the *eighth* on the amended list. The wood is alder. This model seemed to be chosen for the purpose of teaching us patience; it being slightly thicker at one side than the other, a very careful working with the small plane was necessary. The alder wood is beautifully marked; and after this model had been nicely finished off, it amply repaid the trouble and time spent upon it. The measure for the exact levelling of the ends was first used in this model; we found it very awkward to handle, though by constantly using it we acquired an amount of dexterity that we could not have believed possible. In addition to the tools mentioned we used the saw, set square, knife and file. The thickness of the ruler is about half-an-inch, tapering on the one side to an edge of far greater fineness than that of the paper knife, which, by the way, must have been a sort of preparation for making this.

The ninth model is a sock-stretcher—'Socker-skopa.' This model is the size of a man's foot, with about 9 inches in length of leg allowed, and is, or—as we were told—ought to be, in the possession of every good housewife. It is used to stretch homespun socks upon when drying, is made of native birchwood. The principal operations are planing and bevelling the edges. The axe is used in this model, and the shape, after being pencilled out, is sawn with a fine frame-saw; sides are rounded with the knife, although the American plane might be used for the work. It must be observed that this is the first article with a surface of more than two inches we have as yet had to plane. The work altogether took about five hours. We are told that the parents round about in the villages are always glad to introduce this article into their homes, as it preserves the shape of the socks better than anything else, and with less trouble.

The tenth model is a spoon. One word here about these spoons. During the course we made altogether six spoons, all varying in shape, size, and uses. Those of my readers who are familiar with the Norwegian spoon, so constantly brought home by tourists as a curiosity, will have some idea of the kind of thing to which I refer. It is usual for these to be made in the homes of the cottagers, but upon comparison with those made at Näas, the work is found to be inferior, being exceedingly rough. The introduction of the spoon is, in fact, the small beginning of that most delightful branch—wood-carving, and they are always looked upon as the landmarks of success. I am bound to say I didn't distinguish myself in this special branch, but the lady who accompanied me most certainly

did, the director on one occasion telling her that no better work had passed from the seminarium than that shown in one or two of her six attempts at spoon-carving.

A great point of success rests in the choice of good wood. This, in the first place, has to be determined by sound, of course preceded by the choice of an *apparently* good piece. Our teacher of Slöjd (Herr Alfred Johansson) was quite an adept in choosing a sound block. He would pick up several pieces in quick succession and as quickly toss them down again, till at last a glad pause would tell us he had succeeded in pleasing himself, and never to my knowledge did either his eye or ear deceive him. I say ear, for this organ plays no unimportant part in the matter. A flaw in wood can be detected to a nicety by its aid, and a flaw in the bowl of a spoon is looked upon as one of the major miseries of Slöjd mishaps; for who is philosophical enough not to writhe when after perhaps working for some hours at the bowl, he comes upon a worm track or a knot that wholly unfits it for its special use. Nothing then remains but to cast it under the bench, and revert to the first process of sound selection.

I trust I have not wearied anyone here. I want to show how habits of extreme care and great perseverance were being inculcated by means of this handiwork, because it is only by such easy stages we can ever bring home these grand though simple truths to children.

A word about the special spoon-tool. For want of a better word I should call it a *spoon-knife*. It is a curved blade of steel, very sharp, measuring about four inches and resembling the ordinary sickle used in some parts of England for cutting grass, but having its edge in a different direction. It is certainly one of the most difficult tools to handle, and the beauty of the article depends almost alone on the skill with which it is used. I have not seen this tool amongst those in use here, either in a wood-carver's or carpenter's shop. I believe that it is substituted by a chisel of some kind. Before the cutting of the bowl is begun, the wood has to be very firmly fixed in the oaken screw of the bench, and the general shape sketched out on the planed surface with a pencil, the block being preserved in its first thickness throughout until the greatest depth is reached, and even then care is required that in cutting out the back part of the bowl one doesn't cut too deeply. Most of the work after the *spoon-tool*, in the small spoons, is finished with the simple Slöjd knife. Many hours were spent by us over these spoons, but it was constantly pointed out the while how much practice we were getting in the various ways of handling this simple tool. The pudding spoons, so cheap in England, are very rough; and after having thoroughly examined some of them, I have come to the conclusion that no carving enters into the work to produce them. The wood chosen for spoons is generally about three times as large as the spoon required, for it has to be made from the very centre, or hardest part of the cutting, and must be chosen from a piece between the joints of the branches. When finished it is polished to a degree accorded to no other article in the course. The model, as will be gleaned from my wordy description, is a favourite both with children and adults alike.

The eleventh model on my list is an ordinary wooden handle, suitable for a hammer. Now, what this lacks in beauty it certainly gains in use, and it does not require such close careful work as the spoon. It is of ordinary size, and no new operation is needed to complete it, but unless cut with a fair degree of success it feels awkward in the hand; and our teacher tested this, I observed, almost by touch alone, just glancing at it first to see that the sides were balanced equally. It is made in this case of birch, and files of different degrees are in great requisition, the curved blade being required for some parts of the handle. I will say here once for all that, as a general rule, we prepared our wood with the axe at the chopping block, then planed a surface, upon which we placed the *pattern model*, roughly drew it out with pencil, and then proceeded to the actual work of making it. This rule had some exceptions, but in no case did we work from a plan previously drawn. Sometimes we completed a work without drawing, save such we made with the different tools. The store of wood cut into convenient lengths, was kept in an adjacent shed, and we were all taught to choose, or help to choose a piece for each article made.

(To be continued.)

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Science Notes.

MR. HARDING has just called attention to the continuance of low temperature. It has now lasted for twelve months. There have been only three weeks since the beginning of last August when the temperature of the British Isles has been above the average, one in March, one in May, and one in July. In the south-west of England there have been three weeks when it has been 9—10 degrees below the average, two when it has been 7—8 below, and seven when it has been 5—6 below the average.

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THE beautiful sunsets of 1883 were supposed to have been the result of attenuated matter in the upper atmosphere from the Krakatão eruption. Doubt, however, has been cast upon this explanation, inasmuch as beautiful sunsets have never been uncommon in this country. Professor Newcomb suggests that observations should be made at the Cape of Good Hope, where the upper air is known to be remarkably free from vapours and finely divided matter. The recent eruption in New Zealand affords a good opportunity for discovering how far the usual white pure twilight of South Africa is affected by the diffusion of volcanic vapours.

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THE annual 'Directory' of the Science and Art Department is always carefully scanned by science teachers. This year the editor has taken a new departure. Formerly there were two directories, one for science and one for art. These are now combined in one volume. This is a decided convenience. There are important alterations. The amount of lien on apparatus and examples is restricted. The restriction on payments in Irish schools has been relaxed.

Changes have been made in certain of the requirements as to works for the 3rd grade art certificates, and also as to the registration of attendance to support claims for payment on the results of 3rd grade art examinations, and also as to some of the subjects of the 3rd grade examination. So far as science teachers are concerned by far the most important innovation is the new alternative syllabus for the first stage of Elementary Chemistry. It has been so arranged as to give a general introductory knowledge of chemistry, and is intended for those students who require some elementary knowledge of this science before taking up other subjects, but who do not propose making Chemistry a special study. It is a most interesting and able summary of facts and experiments, occupying nearly twelve pages of the Directory. We feel sure this alternative subject will become popular both with teachers and pupils.

Nor are the changes confined to Chemistry. The careful reader will see them in various subjects, notably in Acoustics, Light, and Heat. It is evident from what we have written that Science and Art teachers must peruse this year's directory with more than usual caution.

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THE report of the Technological examinations of the City Guilds has just been issued. Examinations have been held in 48 subjects. The subjects in which there has been the greatest increase in the number of candidates have been Mechanical Engineering, Plumber's work, Electric Lighting, and Gas Manufacture.

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M. GASTON TISSAUDIER has given an account in 'La Nature' of his recent attempts at aerial photography. The highest altitude reached was 1700 metres. About 30 instantaneous photographs were taken at altitudes varying from 800 to 1000 feet, some of which are excellent. Ballooning is evidently destined to play an important part in modern warfare.

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PROFESSOR ROWLAND, the celebrated American physicist, delivered an address at the recent anniversary of the John Hopkins University. His subject was the Physical Laboratory in Modern Education. Some of his remarks on the American schools will be of interest to those in this country who believe that in the matter of education we have much to learn from methods adopted in the States. 'Those who have studied the present state of education in the schools and colleges tell us that most subjects, including the sciences, are taught as an exercise to the memory. I myself have witnessed the melancholy sight, in a fashionable school for young ladies, of those who were born to be intellectual beings reciting page after page from memory, without any effort being made to discover whether they understood the subject or not. There are even many schools where the subject of Physics, or Natural Philosophy itself is taught without even a class experiment to illustrate the subject and connect the words with ideas. If one were required to find a system of education which would the most surely and certainly disgust the student with any subject, I can conceive of none which would do this more quickly than this method, where one is forced to learn what he does not understand.'

The object of education, the Professor says, is not only to produce a man who knows, but also one who does, and to produce men of action students must be trained in action. If the languages be studied they must be made to translate from one language to the other until they have perfect facility in the process. If Mathematics be studied they must work problems, more problems, and problems again until they have the use of what they know. If they study the sciences they must enter the laboratory and stand face to face with nature; they must learn to test their knowledge constantly, and thus see for themselves the sad results of vague speculation; they must learn by direct experiment that there is such a thing in the world as truth, and that their own minds are most liable to error.

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ATTENTION has lately been called to the drying up of the Siberian lakes. This appears to have been progressing with great rapidity. Sheets of water which were eight miles long and wide 25 years ago are now little more than ponds. The same process is going on in Western Siberia, and in the whole of the Aral Caspian depression.

The 'Practical Teacher' Sale and Exchange Column.

Owing to numerous requests, we have been induced to start this Exchange Column for the benefit of our readers. We shall be glad to insert announcements relating to the 'Sale or Exchange' of books, etc., at the rate of ONE PENNY PER LINE, *prepaid.*

For Sale:—Collier's Advanced History (3s. 6d.), 2s. 4d.; Will's Synopsis of English History (2s.), 1s. 4d.; Brief Annals of England, Senior Date-Book (9d.), 6d.; Cassell's Lessons in French, Two Parts (4s. 6d.), 3s.; Hughes's Class-Book of Physical Geography (3s. 6d.), 2s. 4d.; Sutton's Elements of Theory of Music (2s.) 1s. 4d.; Bryce's Grammar of Latin Language (2s. 6d.), 1s. 8d.; D'Aubigné's Histoire de Bayart (2s.), 1s. 4d.; Leslie's Elementary Manual of Music (1s.), 8d.; Skertchley's Elements of Geology (1s.), 8d.; Racine's Athalie (1s.), 8d.; Griffith's School Management (1s.), 8d.; Angell's Magnetism and Electricity (1s.), 8d.; Ever's Land and Marine Engine (1s.), 8d.; Pupil Teacher's Hand-Book (6d.), 4d.; Gill's Plane Geometry, 2nd Grade (6d.) 4d. All in good condition. Address, Teacher, 89, Goddard Street, Crewe.

For Sale:—20½ Sup.-Royal 4to Vols. of Picturesque Palestine, with 600 engravings on steel and wood, in good condition, published at £1 2s. 6d., take £3. One Vol. Cassell's History of England (1798-1837), half bound, published at 21s., good condition, take 10s.

Life of Canon Kingsley (New) 6s., price 3s. 4 Vols. of Shakespeare's works, quite new, published at 1s. each, viz., Richard II., Macbeth, Julius Cæsar, Julius Cæsar, will take 8d. each. Reade's 'How to Write English' at 1s. 6d., price 8d.; Dick's Geography and Atlas (2s.) 1s.; Lund's Geometry and Mensuration (3s. 6d.), 1s. 8d.; Collier's British Empire, Senior (3s. 6d.), little soiled, otherwise good condition, 1s. 3d.; Phrenological Instructor (2s. 6d.) 1s.—Schoolmaster, Elvetham, Winchfield, Hants.

Typical Schools which I have Examined.

By an Inspector of Schools.

INTRODUCTORY.

SIR JOHN LUBBOCK once stated his opinion that the intellect of an English child does not differ very materially in any given part of England. The raw material

is, he thinks, pretty nearly the same. We are on the whole inclined to agree with him. There is not, in our opinion, any very marked difference in the natural capacity of a northern or southern, an eastern or a western English boy or girl. On the other hand, the surroundings of the children of a Lancashire or Yorkshire artisan, and those of a Devonshire field labourer are so different, and have produced in the one instance such a quickening influence, in the other such a deadening effect on the natural intelligence, that Sir John's assertjon would be stoutly disbelieved by the majority of his fellow-countrymen. No doubt it is true that the children of north country operatives derive from their newspaper-reading parents a larger vocabulary and a greater general knowledge than the children of the agricultural classes in the south have attained to, or are likely to attain to for years to come. But given a really good teacher—a master or a mistress capable of wakening the intelligence and stimulating it into continued activity—we give it as our deliberate opinion that for all practical purposes young Hodge is as well endowed with reason as young Milner, the future mill-hand of the north.

It will be observed that we have made reservations. We have said 'with a good teacher.' And we have further said 'for all practical purposes.' We do not think that an average teacher could make a good school out of a school full of young Hodges, while we concede that he could readily do so with a school full of young Milners. And we do not see any practical purpose in teaching young Hodge animal physiology or other specific subjects. We are quite content that he should be well grounded in the elementary and extra subjects. In these it will be found that in spite of a necessarily lower average attendance, and their government by less highly trained teachers, the agricultural schools fairly hold their own. We have endeavoured to establish this contention at the outset in order to prove that typically good schools may be found all over England under apparently the most adverse circumstances. Mr. Matthew Arnold's recent report upon continental schools goes to prove that continental teaching is superior to ours in the intelligence of its methods, and in the capacity of the foreign teacher for keeping in touch with very large classes of scholars. In sheer mechanical results we hold our own.

Now with the utmost respect for Mr. Matthew Arnold, as an old educational hand, we venture to point out that however fine a critic he has proved himself to be, he was always wanting in the quality of all others most necessary for stimulating intelligent teaching—he never had the reputation of being an enthusiastic inspector. Other inspectors, and more especially the younger ones, have succeeded in stirring the imaginations of teachers by leading movements such as the higher education of assistant and pupil-teachers, and by addressing in person large gatherings summoned to consider some critical educational question.

As a poet Mr. Arnold is greatest in elegiacs, as an educationist he is greatest as a critic, and we fear an elegiac one. His attitude on the fees question also shows a want of backbone for which we were not prepared. Mr. Arnold finds that fees have a good effect on education abroad as well as at home. Yet rather than make free education a burning question he would allow ignorant demagogues to sweep them away. This, of course, would involve an enormously increased school rate. Does Mr. Arnold believe, with his experience of the metropolitan ratepayer, that that liberal handed being is quite prepared to raise the intelligence of our teaching to the continental level by lavishing his money on primary, and we presume on secondary, education with the same avidity as the Parisians or the Swiss. Of course we have not had the opportunities of Mr. Arnold in comparing Bavarian, French, and Swiss teachers with those of his City of London district. But we venture to state that we could show him typical schools in different parts of England which with all the disadvantages of our present code—and they are many—would bear favourable comparison with his continental ones. Did Mr. Matthew Arnold before undertaking his mission abroad take the trouble to visit such schools as are to be found in Liverpool, Manchester, Todmorden, Nottingham, Halifax, and parts of Kent;—and, for all we know, there may be better schools in England still—or has he contented himself with his recollections of his own uninspired City schools, backed by the blue book opinions of colleagues who share his views.

We propose to show in a series of papers that within the limits of our own experience, which only extends to seven counties, there are types of English schools exhibiting such admirable ability on the part of their teachers that they would deserve to be called model primary schools in any European city.

In confirmation of what we have said about the teacher making the school, we proceed, in the first instance, to submit the case of a school of 240 (mixed and infants) in a county which less than a generation ago was marked almost black upon a map in which the absence of shade indicated intelligence and the abundance of it gross intellectual darkness. The school in question was then non-existent, and the ignorance of the parents of the present scholars shows how they have suffered by the then deficiency. The teacher has therefore to contend with ignorant parents who are not specially concerned in their children being better informed than themselves. The attendance authority, to which he ought to look for help, is lax in exercising its compulsory powers. The school is a district one in a moderately-sized village, fed by nine small hamlets, one of which is 3½ miles, four 3 miles, one 2 miles, two 1½ miles, and one a mile away.

The district is a rainy one and the country unsheltered; it will be seen, therefore, what the difficulties of school attendance are.

Yet the master, who, by the way, is organist and Sunday-school superintendent and teacher as well, has not only kept his school together but has actually earned nearly a guinea a head per standard scholar and 15s. 6d. a head for the infants whose instruction he daily supervises.

But this is perhaps a somewhat sordid way of viewing his work. He is a teacher of rare moral purpose, has been specially selected to give model lessons in religious subjects to large bodies of Sunday school teachers, and is so keen about acquiring the best and latest practical ideas in education that he is now spending a portion of his summer holidays in visiting leading London schools. Since the merit grants were introduced he has been invariably awarded the 'excellent' one. His First Class and Infant Time Tables and the following memoranda relating to his work, will in a large measure explain his success to readers of the PRACTICAL TEACHER.

SCHOOL LESSONS—1ST CLASS AND INFANTS.

Morning.

HOURS.	CLASSES.	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.
9.30 to 10.20	All	Prayers and Religious Lesson	Prayers and Religious Lesson	Prayers and Religious Lesson	Prayers and Religious Lesson	Prayers and Religious Lesson
Mark and Close Registers by 10.30 a.m.						
10.30 to 11.20	1st Class	Arithmetic	Arithmetic	Arithmetic	Arithmetic	Reading and Recitation
10.30 to 11.15	Infants	Reading and Recitation	Arithmetic	Reading	Reading and Recitation	Reading and Recitation
Playground 5 minutes (1st class), 10 minutes (Infants).						
11.25 to 12.5	1st Class	Composition	Composition	Composition	Composition	Arithmetic
	Infants	Arithmetic	Reading	Arithmetic	Writing	Writing
12.5 to 12.45	1st Class	Reading and Recitation	Reading	Grammar	Reading	Grammar
	Infants	Object Lesson	Writing	Writing	Arithmetic	Arithmetic

Afternoon.

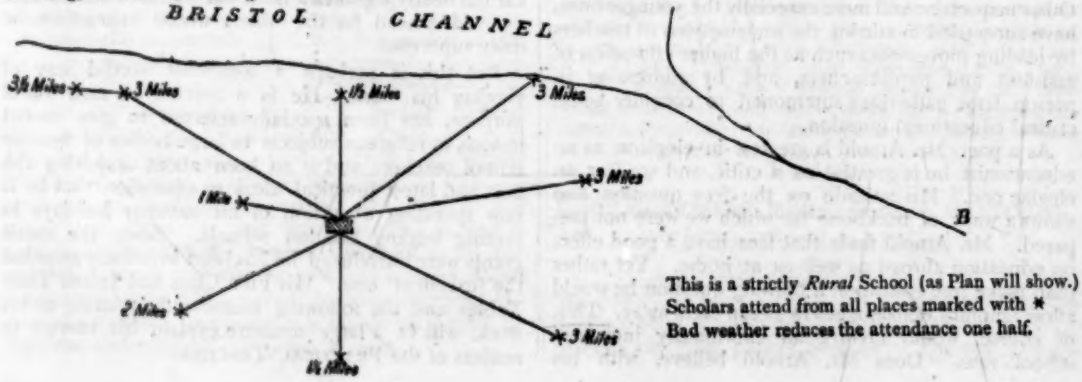
HOURS.	CLASSES.	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.
2.0 to 2.50	1st Class	Reading	Arithmetic	Reading	Arithmetic	Reading
	Infants	Arithmetic	Reading	Arithmetic	Reading	Reading
Call, Mark, and Close Registers by 2.20 p.m.						
2.50 to 3.35	1st Class	Arithmetic	Geography	Arithmetic	Geography	Arithmetic
	Infants	Writing	Arithmetic	Reading	Arithmetic	Writing
3.40 to 4.30	1st Class	Entering Sums in Ciphering Books, Penmanship	Singing	Geography	Reading	Object Lesson on Museum
3.45 to 4.30	Infants	Reading and Recitation	Singing	Kinder Garten	Writing	Arithmetic

No. on *Books during* Year ending 28th February, 1886—287. No. on *Books* at end of Year (omitting those left)—239. Average for Year—203.

Needlework for Girls, Monday, Wednesday, and Friday Afternoons, 4½ hours.

,, ,, Infants, Tuesday and Thursday Afternoons, 3 hours.

The *Recitation* is given with the *Reading* Lessons, and the *Grammar* Lessons are simply Parsing, Analysis, and Sentence Building, &c. *Drill*, &c., is given between Lessons.



This is a strictly *Rural* School (as Plan will show.)
Scholars attend from all places marked with *
Bad weather reduces the attendance one half.

—— SCHOOL.—(MIXED AND INFANT CLASS); on Books, 240.

LAST REPORT (H. M. I.)—March, 1886 :—

'Mr. —— has worked with his wonted energy, and has succeeded in keeping up the high state of efficiency for which his school has been noted in the district. The Reading and English are very intelligently rendered, while the Arithmetic, Writing, and Geography are taught with masterly skill and success. Indeed the results are such that we can call it an Excellent School without hesitation. The Infants are well and intelligently taught by Miss ——." Fixed Grant, 4s. 6d.; merit, 3s. Infants, 9s. and 6s. Class Subjects: English, 2s.; Geography, 2s.; per centage of passes, 95. Grant, £194 16s. 9d.

DIOCESAN INSPECTOR.—November, 1885 :—

'An excellent school in all respects; repetition, writing out, and answering being all that could be desired. The tone is thoroughly good, and the discipline easy but perfect. It is a real pleasure to visit such a school.'

Discipline.—A large copy of the article in the Code on Discipline and another by the S. P. C. K. on the Moral Tone of a School, are hanging on the wall in front of the scholars. The principal teacher refers to the requirements in the audience of the scholars from time to time.

Homes and Parents.—The principal teacher frequently visits the scholars' homes, and invariably does so when children give trouble by irregular attendance, by unpunctuality, by bad conduct, by neglect of Home Lesson, by want of cleanliness, &c. This is of great use when parents co-operate with the teacher, and in all cases it reminds parents of their duties to their children.

Home Lessons.—These are chiefly memory lessons and reproduction of school work. Delicate scholars are exempt from them. A list of the best Home Lessons is posted up in the school weekly, and specimens of the best are hung on the walls.

Grammar and English.—Children are encouraged to answer in complete sentences. Sentence building is taught from Standard II. upwards. Suitable motions and actions of the body are given with the recitation.

Geography.—In addition to the Geographical Readers and Maps purchased, the principal teacher has made on black boards, skeleton maps in paint, of England, the county, Canada, Europe, Phases of Moon, Planetary System; also for Staadard II. a large relief map, with putty for mountains, the land painted brown, the water blue, &c.

Reading.—The Time Table is so arranged that each class can have a reading lesson in the class-room in turn—a shortened method of Mrs. Fielden's signal system is used. The teachers are instructed to read to the scholars frequently by way of pattern.

Time Table.—

a.m.	Hours 9.30 to 10.20	Religious Lesson.
	„ 10.20 to 10.30	Registers marked and closed.
	„ 10.30 to 12.45	Secular Lessons.
p.m.	„ 2.0 to 4.30	„ Registers marked and closed by 2.20.

The entries in the Class Registers are verified at every marking by counting the number present in the classes. The registers are also tested by the acting manager at intervals.

Museum.—The Museum contains specimens of common groceries, mineral ores, cotton, wool, silk, honeycomb, hops, picture of British trees, &c. Notes of lessons on the contents are written, and a short lesson is given weekly as an object lesson.

Library.—139 volumes lent to scholars weekly.

Infants.—Taught in infant class room. Flowers and pictures brighten the room. Domino sheets, bead frames, form and colour illustrations are used. The black boards are painted to receive the copy daily, and the slates are ruled for writing and arithmetic. The principal teacher has made a model in wood of the school buildings, which the infants put together as an exercise in Kindergarten. He has also prepared a book full of object lessons on animals, flowers, ships, common things in nature, &c., which are given during the year. Stick laying, paper plaiting, letter building, building with blocks, designing forms with silk on cards, paper plaiting, and mat making with wool on rings, have been taught in Kindergarten lessons. The principal teacher prescribes and prepares infant lessons and revises them daily.

(To be continued.)

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AWARD LIST
OF THE
'PRACTICAL TEACHER'
10-Guinea Writing Competition.

J. H. COWHAM, Esq., F.G.S., of the Westminster Training College, has kindly acted as Judge.

CLASS I.—Pupil Teachers.

FIRST YEAR.

Males.	*Females.*
IVANHOE.— George T. Bonner, 55, Ramshaw Street, Scotswood Road, Newcastle-on-Tyne.	NANCY LEE.— Annie Cook, Barton, Ampthill.

SECOND YEAR.

BEACONSFIELD.— Edgar James Turner, 12, St. Stephen's Road, Burmantofts, Leeds.	IDA.— Ellen Irlam, Lees Street Congregational School, Higher Openshaw.

THIRD YEAR.

TYCHÉ.— Frank Oldham, Mount Terrace, Crawshawbooth, Near Manchester.	STANCIE.— Constance E. Taylor, Sutton Schools, Isle of Ely.

FOURTH YEAR.

TELEGRAPH.— Percy Sutton, 1, Norman Street, Dover.	TENNIS.— Mary Lynex, The Moor, Kirkham, Lancashire.

CLASS II.—Open Competition.

MOUCH.— F. Ball, 29, Penydarran Road, Merthyr Tydfil, South Wales.	LAWN.— Mary Lynex, The Moor, Kirkham, Lancashire.

Publications Received.

Ballière, Tindall, & Cox.—

Intermediate Arts Guide for July, 1886.

Bell, G., and Sons—

Greek Testament Selections. By A. M. M. Stedman, M.A.

Chambers, W. and R.—

Cæsar. Book I. With Notes, &c.

Heywood, John—

The 'Castle' Certificates.

Kidd, W.—

The Competitor's 'Vademecum,' by J. Turner.

Laurie, T.—

Diagram of Laurie's Kindergarten Toys and Occupations.

Geography of England and Wales, with Maps. By T. M. Davidson, M.A.

Longmans and Co.—

Longmans' Magazine. August.

Longmans' New Reading Sheets.

Murby, T.—

The Imperial Drawing Books.

The Musical Student's Manual. By T. Murby.

Philip, G., and Son—

Geography of the British Colonies and Foreign Possessions. By Rev. T. P. Faunthorpe, M.A., F.R.G.S.

Standard Test Maps for Memory Work—England and Wales, Ireland, Scotland, and the British Isles.

Swan, Sonnenschein and Co.—

Pond Life: Insects. By A. Butler, B.A., B.Sc.

The Elements of Plane Geometry. Part II.

Smith, Elder and Co.—

Suggestive Lessons in Practical Life. First, Second, and Third Series.

The Cornhill Magazine. August.

Publications Reviewed.

School Work. By F. G. Gladman, B.A., B.Sc., late Superintendent of the Central Training Institution, Melbourne; and formerly Head Master of the Model and Practising Schools, Borough-road, British and Foreign School Society. Part I. Control and Teaching; Part II. Organization and Principles of Education. London: Jarrold and Sons.

A brief preface to this book informs us that '"School Work" was left at the author's death in manuscript, ready for the press, with a request that his friend, Mr. G. E. Buckle, would read through the proofs, and make those alterations in the matter rendered necessary by the latest Departmental regulations. The book embodies the results of a long experience. It has been the work of several years, every part of it having been carefully thought out, and the greater portion revised and rewritten again and again.' The work thus touchingly introduced to our notice is in every way remarkable, comprehensive in plan, almost if not quite unique in style, intensely practical, every section breathing the spirit of an ardent educationist, and rich with the fruit of wide and careful reading, tested and ripened by a wise use of unusual opportunities of observation and practice in the daily work and life of school.

The scope and design of the work embraces the four great parts of School Management and Instruction, comprised in Discipline, Teaching, Organization, and Principles of Education. And the subjects are treated in the order named. This inverts the order usually followed in treatises of the kind. The more usual course is to go from the theory to the practice of education. A statement of principles precedes the consideration of methods of teaching. Indeed the larger and more important works on Education are confined almost wholly to a theoretical discussion of its principles; few of the writers of such books having practical knowledge of the application of those principles to the daily life of an elementary school. Here the author puts himself to the task of setting forth, first of all, how the teacher is to control and manage his charge, next, how he is to instruct them. He then passes on to the consideration of the arrangements and means by which the work is to be accomplished, and lastly, deals with the great educational principles involved in Mental and Moral Science, and in a knowledge of the physical nature of a child. He thus pursues the path which must ever be trodden by the great majority of school teachers. Few of these can defer the practice of their art till after they have mastered the science on which it depends. The author recognising this fact tells us that 'the arrangement in the text has been adopted because it favours more direct dealing with some of the young teacher's greatest difficulties, and because it allows more homely mention and treatment of other important matters.'

The style of the work is peculiar, both in the arrangement of the matter and in its detailed expression. Thus, beginning with 'Managing a Class,' the first page plunges us at once *in medias res*, without circumlocution or preliminary statement of any sort, by setting forth what appear to be the heads, and subordinate parts of a class lecture on the subject. This unusual style looks, at first sight, like 'dry' reading. It is followed by detailed amplification of each part in subsequent pages, after reading which, if not before, the value of the summarized outline is realized. In the same way most of the important sections in Part I. are preceded by a detailed syllabus, showing the topics treated of, and the chief points presented in each. This tends to great clearness, and, by reiteration, to a more definite fixing upon the mind of what has been read. The teaching habit of the author has probably led to this mode of writing. Long experience had taught him how much the exact and complete attainment to knowledge of any kind depends on a clear presentation of what has to be acquired, and on constant recapitulation and revision; and what he has found so helpful to his scholars he employs for the benefit of his readers.

The style of expression is singularly clear throughout, no attempt is made at graces of diction, at polishing the periods, at rounding off the sentences. The one purpose of the author is evidently that of saying what he has to say in the clearest, simplest, briefest, possible way. Page after page is filled with terse, crisp, compact sentences, full of matter, often in the form of sententious aphorisms, short, pregnant quotations, statements of principles, rules for the guidance of the teacher, all put forcibly, sometimes with the free, easy, conversational style of one speaking with the readiness of complete familiarity with his subject, regardless of formal grammatical exactness, even at times without conformity to ordinary grammatical rule. It is pre-eminently a book written for the practical guidance of teachers; not for readers who merely wish to be informed about them and their work. The writer had the teacher and his work clearly before him in every paragraph he wrote. Throughout he is true to his title, 'School Work.'

This fixed purpose of directness of aim and thoroughness is curiously emphasized by the adoption of all sorts of expedients in the mode of printing the book. All is done to this end that can be effected by varieties of type, numbering and lettering of paragraphs, spacing, bracketing, headings, and the like, carried sometimes, it might seem, to excess, but in the general result eminently impressive of the author's intent. It has already been observed that the book is intensely practical. This is one of the most marked features. The writer has evidently brought to the test of daily school work every method and rule of procedure enunciated, and as the result of thoughtful observation, commends or condemns it accordingly. So with the statements of general principles there is associated with all of them, sound practical advice as to how they should be applied in the actual dealing with scholars.

The amount of general reading brought to bear upon the subject is extraordinary. A list of the names of authors quoted in this work would include the names of almost all educational writers of eminence from Comenius to Bain and Herbert Spencer. And the quotations are not less apt than varied. The references to the many writers whose works are laid under contribution, form a valuable guide for the direction of the teacher who wishes to go more fully into this great subject. The book is divided into two Parts. :—PART I. deals with what is directly practical in the work of a School Teacher, and is considered under the two great divisions of Control and Teaching. The subjects comprised under Control are respectively: Managing a class, Order, Attention, Discipline, Rewards and Punishments. It may be said in brief, that each of these topics is dealt with in a manner worthy of its prime importance in the school education and training of children. What each term signifies, how what it represents is best to be secured, the effect of neglect of it, the mistakes made too often by mis-directed efforts to secure it, are minutely detailed. No phase or aspect of the subject seems overlooked; all are dealt with fully, and in a thoroughly sensible manner. The section on Discipline is particularly valuable. It could have been written only as the result of much intelligent observation and experience. Its relation to the teacher, to the scholar, to school arrangements and methods, to order, obedience, and habit, is clearly set forth, and the means and processes necessary to ensure it are well detailed. The due effect on School Discipline of authority and sympathy, and a clear insight into the meanings of words and things bearing on it are admirably enforced by a multitude of quotations from many authorities. A great and accurate knowledge of boy nature is manifested, and of the best mode of dealing with the motives and tendencies revealed by it. Throughout, a high ideal of the teacher's calling and duty is sustained, as opposed to the hard driving and striving after results too commonly induced by the pressure of modern School requirements.

The difficult subject of Rewards and Punishments is discussed in an equally sensible manner. The objections, difficulties, and modes of applying various kinds of punishment, the conflicting views and practices of writers and teachers, are calmly and judiciously treated, and while no dogmatic ruling on one side or the other is attempted, the conclusions arrived at by the writer are forcibly stated together with the grounds on which he founds his decision.

The all-important matter—Teaching—is treated with similar fulness, good sense, and exactness. The distinction between teaching and learning, instruction and training, is clearly maintained and the relation of each to each is well defined. Not less suggestive or admirable are the remarks on the personal qualifications of a good teacher, and his acquirements, and this fitly introduces the subject of Method proper. Nowhere else have we seen this much discussed topic so exhaustively treated, and nowhere more admirably. Every feature seems to be treated methodically, its bearings thought out with great intelligence, and expressed with much acumen. What method is, its various forms and parts, as telling, eliciting, illustrating; the modes of grouping, individual, simultaneous, collective; inductive and deductive methods of approaching a subject of study, with the corresponding analytic and synthetic methods of teaching, are detailed clearly, and with great fertility and amplitude of illustration. Arithmetic, Grammar, Writing, Oral Lesson-giving, Geography, all in turn furnish examples by which to point the suggestions.

Oral Lesson—giving follows naturally after Method, showing the practical application to daily class-work of what has been there laid down. Amongst other things equally good, is an excellent summing up of the best features of class teaching in the section headed 'Some marks of a good collective lesson,' in which, while indicating what these are, there is well stated incidentally the mode of securing them. This is followed by sound and sensible remarks on 'Home Lessons.'

Reading as might be expected comes in for ample treatment. As there is no ordinary subject of school instruction more important, so perhaps there is not one on which greater ingenuity of plan and device has been expended. So much is this the case that 'method,' so called, has been greatly overdone. The supposition is not rare that there is a virtue in *Method*, however applied, that will supply every need. No doubt good method counts for much, but in every part of school work, and here emphatically, is good sense, intelligence, and the personality of the teacher, of prime importance. This is well brought out by the Author, who states with perspicuity and exactness the various methods of teaching to read, the best modes of applying them, the excellences of each, and their inherent weaknesses. How to teach reading to infant, junior, and advanced classes, and its cognate subject, spelling, are noted with surprising minuteness and accuracy. Similar care marks the author's treatment of Writing.

The pressing claims of Arithmetic meet with due recognition. The ground is well cleared for a statement of the principles and the practice herein involved, and illustrations are freely and excellently given in all grades of treatment, both of class and of subject, to exemplify what is advanced. Besides explaining the courses commonly adopted by teachers, special methods are detailed, prefaced by the statement that 'every suggestion is the fruit of experience, and has been tested in the author's practice.' The whole forms a clear statement of what has proved best and most successful in the treatment of this important subject. The author goes on to treat Geography, History, and Grammar with similar care and skill. Nothing more admirable has been written for Elementary School teaching in reference to these subjects. Common mistakes are pointed out, schemes of lessons are set forth, ordinary and special devices of method and illustration are explained, and excellent suggestions given for teacher, pupil-teacher, and scholar. Capital directions are given as to the spirit and mode in which to prepare lessons; some of the 'specimen notes,' however, especially of history lessons, may perhaps be not unjustly spoken of in more qualified terms, as being too elaborate, and presenting too much for the assigned class. This brings us to the close of Part I. For a treatise otherwise so complete, it is somewhat surprising to note the omission of any reference to the teaching of Needlework and of Singing.

PART II. treats of Organization and Principles of Education. The former of these topics is one on which less is said, in works on Education and on School Management, than on any other subject involved. These are usually fertile in principles and overflowing in methods. Educational principles are specially matters of theory. So also is Method to a great extent, which may be applied more or less exactly to any number of scholars in any mode of arrangement. The Organization of a public elementary school is a different matter. It can only be acquired by actually putting it into practice. Those who have devised and carried out a scheme of arrangement for such schools are very few. It has been the statement of principles, and the application of them to methods of

instruction, on which writers on education chiefly give light. The three men who have done most in the direction of School Organization are Bell and Lancaster, devisers of the Monitorial system, and David Stow, founder of the collective system of organization. The arrangement of an English public elementary school is largely a combination of these methods, modified to suit the working of it, by a head teacher, assistants, and pupil teachers. Hence the pertinence of the author's remark, 'Writers on education often deal with their subject as though the teacher were concerned with only one child. What they say is often inapplicable to groups (classes and sections), and still more to large numbers (schools as a whole.)'

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In the chapters on 'The Mind, and Intellectual Education,' 'The Will: and Moral and Religious Education,' the author takes us to the highest range of his great subject. And here also he guides us with no faltering footstep, or unsteady hand. We have presented to us in somewhat elaborate detail the main facts and principles of psychology as applied to education. Starting with a statement of Hamilton's, and of Bain's arrangements of the phenomena of mind, we are shown wherein they harmonize, and where they diverge. The constitution of mind, the process of the formation of ideas, the growth of knowledge, the conditions of good Perception, of Memory, and of the 'Elaborative Faculty,' or Judgment, in its widest sense, are amply described, somewhat in the usual order it may be, but with most unusual closeness and clearness of application to the common details of school work. It is interesting and refreshing to see how naturally, in this course of thought, there come in disquisitions of some length on 'Object Lessons,' 'Colour and Form,' and a brief, but clear and good, account of the 'Kinder Garten.' It would be well for elementary education if every teacher of the young were 'possessed' of the information conveyed in this section of the book, and animated by the spirit which it exemplifies. He who thoroughly masters it will be well acquainted with the nature of the material on which he works, and if he apply it as here directed will prove an apt workman, well skilled, and well equipped for his arduous work.

'The Will' is dealt with in a similarly detailed and practical fashion. The conflicting theories of Conscience as to whether it is 'a simple, primitive, independent faculty,' or whether it is 'derived and dependent on education and circumstance,' are briefly indicated and supported by quotations on the one hand from Chalmers, on the other from Bain. The diverse views, too, entertained of morals and religion, their mutual relation, and their place in the education of children, are presented with great candour, and the whole subject is handled in a wise, reverent, and impressive spirit.

There is a chapter on Physical Education replete with good sense, and an Appendix treating of Psychology and Logic. This is necessarily somewhat technical, but is well worth careful perusal, as a valuable guide for thought, and for accurate use of language. This section affords a good illustration of the clear headedness of the author, and of his faculty of making plain to his own mind whatever he looked at, and of putting it into clear forcible expression.

From what has been said it will be seen that we have been dealing with a book of no common order. There are larger and fuller treatises on some branches of the wide subject treated of, notably on that of Mental Science; there are well written books on School Management and Method which give the results of careful thought, of wide experience, and of good acquaintance with educational literature, but no book has come under our notice which combines so complete and satisfactory an account of all the various topics involved, with such a closely practical application to school life, or which blends in equal degree so wide and varied a reading of educational theory with so large an actual experience of its bearing on elementary school work.

We commend the work most heartily to the attention of our fellow-teachers, in the conviction that no safer or more satisfactory guide can be followed by them in the pursuit of their noble calling.

School Management and Method, in Theory and Practice.

By John J. Prince. Fourth Edition, Revised. J. Heywood: Manchester.

The Preface to this book informs us that though one of the objects of the work is to furnish teachers with information, &c., 'Yet the *chief* and *primary* object of the Author is to furnish candidates, students, and pupil, and acting teachers with such information and assistance that they may be able to answer successfully the questions which may be proposed to them at the Examinations for Scholarships and Certificates.' This, doubtless very useful purpose, limits and affects the whole scope and tone of the book. So much is this the case, that more than a hundred pages, that is, more than one third of the entire book, are occupied with questions and answers, or questions only, as set at the various Scholarship, or Certificate Examinations.

It is perhaps scarcely to be expected that we should find in a book thus limited as to its purpose anything like a complete view of the general principles of the Science and Art of Education. Yet it is somewhat surprising that no notice is taken, for example, of the simpler facts of Mental Science in their bearing on child

training. No teacher can be adequately equipped for his work who has not at least an elementary knowledge of the constitution and development of a child's mind, and of the relation between the laws of mental action, and the rules and processes of daily school work. And indeed for some years past this has been recognized in the Syllabus annually issued to Training Colleges, on which the questions set at the Certificate Examination are founded. It is fairly open to question, whether harm is not done, educationally, both to teacher and to scholar, by the too frequent use of text books which are prepared with an eye to the examination only or mainly. It helps to exalt the examination into undue prominence. It makes it too much the end of school work, instead of its being viewed as an accident, and a mere test of certain results in a process which should have a much higher aim than merely to prepare for passing the Examination. And this is an evil of no inconsiderable magnitude in modern educational arrangements. Having said this, however, we may fairly say that this is a good work of its class, dealing sensibly and very practically with the topics on which it treats.

The work is divided into four parts, dealing first with School Management, and Method. Then follows a section on the Investment of Savings, and Sanitary Matters. The fourth part consists of Examination Questions, with Hints and Answers. The limits prescribed by the Author excludes any reference to the specialities of Infant Schools and of Girls' Schools. Some brief but sensible remarks on The Schoolroom, are followed by a useful chapter on Organization of an Elementary School, including references to School Furniture, Classification, and the Construction of Time Tables; School Registers are then described, the mode of keeping them, and the use which a teacher may make of their records in dealing with his classes. The chapter on School Government and Discipline is very practical; and the suggestions as to the moral discipline and control are evidently the result of careful observation, and an honest and earnest discharge of a teacher's duty.

Part II., Method, begins with a chapter on class teaching and questioning. Good practical directions are given as to the preparation and delivery of lessons. The author's remarks upon the 'Manner of the Teacher' are very good, and such as, being borne in mind and well applied by young teachers, could not fail to be productive of valuable fruit. There are good suggestions as to the construction of Notes of Lessons, among which, however, we do not rank the following:—'There must be two columns: one to show the subject matter of the lesson, and the other, the method proposed for the teaching it.' The author's own examples, given in the answers to Examination Questions, illustrate the impracticability of following so absolute a rule. The Method column contains a great deal more of the 'Subject Matter' than of 'Method' proper. It must ever be so, and even if there could be this strictly defined division in the notes, it would be misleading. Matter and Method are inextricably interwoven in the giving of the lesson, and there seems no necessity for separating them in the notes. Some words and phrases are used in this connection which should have been explained. Thus, the teacher is recommended to use sometimes 'The inductive process; at others the synthetic, interrogative, etc.' How is a teacher who is at the stage needing this direction to distinguish between these methods without some explanation of them? And may not a synthetic process, be at the same time interrogative? A list of lesson books is given for the information of teachers, from which are strangely omitted some of the most valuable of recent years.

Questioning and answering are well dealt with.

The methods of teaching reading, spelling, writing, and arithmetic, according to the plans usually adopted, are set forth in the practical way which characterizes the teaching of the book generally. Much useful knowledge is presented, that on the teaching of arithmetic being especially good. Some special methods of treating different portions of the work are presented. Many of them seem good and fairly practicable. Others, in our estimation, are less satisfactory. An illustration of the latter sort occurs in section Writing, in reference to 'the teaching of the capitals.' 'When teaching these the letter *S*' (so printed) 'must be taken first, it being *the key* to the majority of them.' Each teacher will necessarily advocate what he finds to be best, but we demur to this mode of 'teaching the capitals' to beginners, as violating the rarely contested principle of proceeding from the easier to the more difficult. The letter *I* would form a more natural and easy beginning, even if Mulhauser's plan be not followed.

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We have already remarked that the examination questions and specimen answers form a very large feature of the book. The answers are not all equally satisfactory. Some are very well given, a few are meagre. As models for an examination paper not a few of the best of them are defective, because they would occupy too much time and space for one question out of the full number to be written on the examination paper.

It would be scarcely right to close our review of a book so sensible and practical, without an expression of regret that it should have reached its 'Fourth Edition, Revised' without a more careful correction of its style and grammar. The following are specimens of a want of accuracy, or of good taste which should not occur in a book written by a teacher for the use of teachers. 'Suppose the lesson to be on the figure eight' (number eight is meant). 'One, two, and five makes eight.' 'Each and all has it in his power.' 'Boys are taught to respect those of the feminine gender' (referring to the teaching of boys and girls in the same school).

Longmans' School Geography. By George G. Chisholm, M.A., B.Sc. London: Longmans, Green and Co.

We are glad to welcome Mr. Chisholm's book as a vigorous example of the vitality existent amongst English educational writers, and of the energy with which they attempt to effect improvements on the old styles of method and arrangement when those old styles seem from experience to be faulty and injudicious.

There is so much that is really trashy produced nowadays for school use, that a volume, showing unmistakable evidence, not only of careful and painstaking labour, but also of original research and arrangement, is all the more to be appreciated. Mr. Chisholm's book bears these traits and is to be esteemed accordingly. In order to properly gauge its value from an educational point of view, there is probably no better plan than by considering, first, the purpose and aim of the writer; secondly, the mode in which that purpose and aim have been carried out; and thirdly, whether the volume thus resulting is likely to be service in practical school use.

With respect to the author's aim, the preface to the book gives us full information. From it we gather that, following German methods as a guide, he has tried to distinguish between what is indispensable as a groundwork and what it is better to neglect if the pupils are really to be educated, instead of having their minds overloaded, distracted, embarrassed, and perplexed. He has therefore sought to include almost all details which pupils cannot be expected to keep permanently in their minds. The method adopted may in fact be somewhat briefly summed up as an attempt to generalise Geography, to exhibit it as a science with recognized underlying principles and rules, and, whilst little or no stress is laid upon such definite details as the lengths of rivers, heights of moun-

instruction, on which writers on education chiefly give light. The three men who have done most in the direction of School Organization are Bell and Lancaster, devisers of the Monitorial system, and David Stow, founder of the collective system of organization. The arrangement of an English public elementary school is largely a combination of these methods, modified to suit the working of it, by a head teacher, assistants, and pupil teachers. Hence the pertinence of the author's remark, 'Writers on education often deal with their subject as though the teacher were concerned with only one child. What they say is often inapplicable to groups (classes and sections), and still more to large numbers (schools as a whole.)'

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It is not usual to find 'The Investment of Savings' and 'Sanitary Matters' gone into in a work of this class so fully as are these sections in this book. Both are lucidly and amply detailed, and much useful information, not commonly accessible, is given.

We have already remarked that the examination questions and specimen answers form a very large feature of the book. The answers are not all equally satisfactory. Some are very well given, a few are meagre. As models for an examination paper not a few of the best of them are defective, because they would occupy too much time and space for one question out of the full number to be written on the examination paper.

It would be scarcely right to close our review of a book so sensible and practical, without an expression of regret that it should have reached its 'Fourth Edition, Revised' without a more careful correction of its style and grammar. The following are specimens of a want of accuracy, or of good taste which should not occur in a book written by a teacher for the use of teachers. 'Suppose the lesson to be on the figure eight' (number eight is meant). 'One, two, and five makes eight.' 'Each and all has it in his power.' 'Boys are taught to respect those of the feminine gender' (referring to the teaching of boys and girls in the same school).

Longmans' School Geography. By George G. Chisholm, M.A., B.Sc. London: Longmans, Green and Co.

We are glad to welcome Mr. Chisholm's book as a vigorous example of the vitality existent amongst English educational writers, and of the energy with which they attempt to effect improvements on the old styles of method and arrangement when those old styles seem from experience to be faulty and injudicious.

There is so much that is really trashy produced nowadays for school use, that a volume, showing unmistakable evidence, not only of careful and painstaking labour, but also of original research and arrangement, is all the more to be appreciated. Mr. Chisholm's book bears these traits and is to be esteemed accordingly. In order to properly gauge its value from an educational point of view, there is probably no better plan than by considering, first, the purpose and aim of the writer; secondly, the mode in which that purpose and aim have been carried out; and thirdly, whether the volume thus resulting is likely to be service in practical school use.

With respect to the author's aim, the preface to the book gives us full information. From it we gather that, following German methods as a guide, he has tried to distinguish between what is indispensable as a groundwork and what it is better to neglect if the pupils are really to be educated, instead of having their minds overloaded, distracted, embarrassed, and perplexed. He has therefore sought to include almost all details which pupils cannot be expected to keep permanently in their minds. The method adopted may in fact be somewhat briefly summed up as an attempt to generalise Geography, to exhibit it as a science with recognized underlying principles and rules, and, whilst little or no stress is laid upon such definite details as the lengths of rivers, heights of moun-

tains, &c., to place before the pupil all those features which best illustrate important and general laws. Mr. Chisholm's aim would evidently be to convert the learner into a geographer, instead of into a mere repository of topographical details. There is no doubt that this ideal is a lofty one and worthy of our sympathetic appreciation.

With respect to the second point for consideration, the manner in which the author has worked out his ideal, there is not much room for two opinions. A careful examination of the volume shows that he has carried it out conscientiously and well. The book is practically divided into two parts, excluding the Preface and prefatory notes—(1) the Introduction, in which the chief points of Mathematical Geography and of Physical Geography are dealt with in an admirable and in some cases exhaustive manner; indeed, much of the information we do not remember having before met with in a book intended simply for school use: and (2) the description of Continents and Countries. We can with justice accord hearty praise to both the quantity and quality of the information given in these two parts: it is superior in every respect to that usually found in school text-books. The statements are made clearly and well, and show an acquaintance on the part of the author with all the latest theories and discoveries in geographical science. There is one point, however, respecting which we would fain make confession. We miss the division into sections and subsections so customary in school books on geography; and though their omission to a large extent in this book is defended in the preface by the author, we can hardly see the force of his argument, which is to the effect that since there is variety to be found in the different countries on the surface of the globe, that variety "cannot be held as adequately described by an enumeration of similar particulars under the same headings." In this particular we feel sure the volume might be improved. All teachers know by experience the value of classification and subdivision, and how much more quickly a subject can be mastered if its various sections are first clearly and definitely sketched out; and how much more readily a group of subjects (such as the description of various countries) can be mastered, if there is a certain similarity of treatment throughout. We do not of course mean to imply that there is no arrangement or classification in the book under discussion, for that there undoubtedly is: but what we do say is that this arrangement or classification under sub-headings is not so patent as it might be, and not clear enough or frequent enough to be of much use to the pupil. Taking France for an example (page 134), the first paragraph might well have been headed "General Description," the second "Coast," the third "Surface," and so on, with undoubted advantage we think in clearness and intelligibility.

Coming now to the third point, the value of the book for practical school purposes, it must be admitted that a new departure of this nature can only be properly tested by experience. We will therefore only say that the author has done his work capably and thoroughly, and that if this new departure founded on continental methods has any real merit, no better text-book than the present could be adopted for putting it to the test. We would add that the book runs to 320 pages, is well brought out, with good printing on good paper, and is illustrated with some sixty or more authentic and carefully selected woodcuts.

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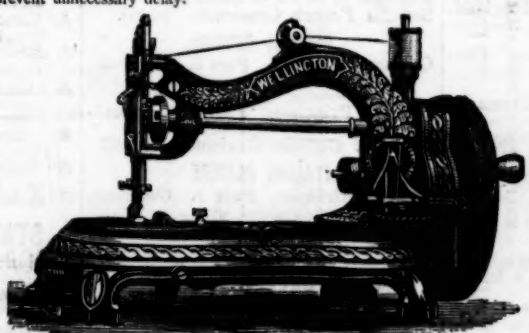

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